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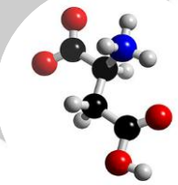
Lie Group and Lie Algebra Application in Quantum System

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Create and Develop Intelligent Building Envelope System: An Integrated Design Approach

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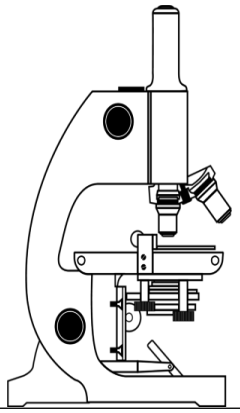
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Guide for Authors

The Butana journal of applied science is a refereed biannual journal published by the college of graduate studies and scientific research /university of al–butana and is devoted to disseminate new knowledge resulting from research ffocusing on applied science papers are accepted for publication on the understanding that they have not been sent to or published elsewhere .The journal also accepts short notes or communication .Abstracts and proceedings of conferences or workshops will be considered for publication . articles may be written eithr in English language with Arabic abstract or in Arabic language with English abstract. Every page should be numbered at the bottom centre.

Preparation of manuscript:

- Submission should be double spaced .
- All margins should be at least 2.5 cm .
- Manuscript must be prepared in time new roman style.

Title:

The title of the paper should be complete , comprehensive and should denote the essence of work . the title should be followed by names of authors without professional degrees and correspondence address including e–mail as afoot note. each author should be identified using last (family name) fully written with initials for first and middle names .the first and the last names of a female author should be printed in a full spelling .

Abstract:

The abstract should not be more than 500 words .it should contain the objective, methods used to conduct the res search , clear description of results and brief conclusion drawn from the results .

Keywords:

Key words should describe the studied problem as best as possible. they should not be more than 7 words .

Introduction:

This section should provide information on importance of the problem and clear objective of the study . every statement must be supported by literary source in journal that has been published to date . it is advised to provide recent references from impact factor journals. References containing one or two names of the authors should be cited by the names of the authors . any reference carrying more than 2 authors should be denoted by first author and et al. should be included e . g (brown *et al* .,2010) .

Materials and methods :

All procedures , analytical methods , experimental design and preliminary materials should be provided with detail in the section. relevant references should be quoted for a particular analytical methodology. Complete statistical procedures should be produced under separate heading of (statistical analysis).

Results:
The results from the experiment including their statistical detail should be presented graphically or in table form . in this section, results obtained should be recorded in text form and table data should not be repeated . Results should be clear and concise .

Discussion:
Detailed discussion should be produced in this section with relevant references preferably most recent citation should be included .Discussion should be very solid and concrete . Results and discussion may either be pooled or presented under separate sections.

Conclusions:
The major conclusions of the study may be presented in a short conclusion section , which may stands alone or form a subsection of discussion.

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Only recent references should be consulted . Name of authors should be mentioned in the text with the year of publication in brackets . List of references should be arranged alphabetically at the end of the paper in the following examples:

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The Experimental Investigations for Micro-Nutrients in Irrigation Water of Cucumber and Okra Vegetables and their Effect on the Consumers

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Abstract

This study was conducted during the period (October 2017 up to June 2018) to determine the Micro-Nutrients of cucumber and okra vegetables from *Assalaya* area and its effect on consumers. The samples were analyzed by using atomic absorption spectrometry (180-30) Hitachi spectrometer Dermstand Germany Samples of vegetables Fruits collected from two different locations were irrigated with drain water came from *Assalaya* Sugar Factory and cane Farms surpluses water to determine the Micro-Nutrients namely (Cu^{+2} , Zn^{+2} , Cd^{+2} and Pb^{+2}). The results were recorded as follows: Cu^{+2} 0.548 mg/kg to 0.551 mg/kg (0.0006 mg/kg) and Zn^{+2} 0.218 mg/kg; (0.002 mg/kg) (0.0006mg/kg) lead and cadmium both of them were not detected in Cucumber vegetable. Cu^{+2} 0.164mg/kg to 0.168 mg/kg; (0.0006 mg/kg) and Zn^{+2} 0.235mg/kg to 0.240 mg/kg; (0.0006 mg/kg) lead and cadmium both of them were not detected in Okra vegetable. A according to the standards from WHO and FAO (0.0006 mg/kg) ,the observed concentrations of Cu^{+2} and Zn^{+2} in Cucumber and Okra were higher than the international standard. Hence the pollution which was observed impermissible ranges of these elements. Conclusively, the drain of sugar factory effluents in *Aljassir* channel and cultivating soil directly caused acute significant pollution and accumulation of some heavy metals in closed channel. A condition that requires further studies and deserves seeking urgent solution for its abatement and isolation., in addition the study recommends treatment of wastewater then put into consideration before reaches the white Nile River and *ALjassir* channel , after that it should be used for agriculture purposes and breeding livestock.

Keywords: ***Micro-Nutrients, Irrigation water, Cuccumber and Okra Vegetables.***

المستخلص

أجريت هذه الدراسة في الفترة من (أكتوبر2017م وحتى يونيو 2018م) لتحديد العناصر المغذية الصغيرة لخضروات الخيار والبامية في منطقة عسلاية وتأثيرها على المستهلك . لقد تم تحليل العينات باستخدام جهاز امتصاص الطيف الذري (180-30) . ثمار الخضروات (الخيار والبامية) تمّ جمعهما من موقعين مختلفين مرويتين بمياه الصرف القادمتين من مصنع سكر عسلاية وفائض مياه حقول القصب لتحديد العناصر المغذية الصغيرة وهي (النحاس، الزنك ، الكادميوم والرصاص) وقد سجلت النتائج القيم

الآتية النحاس 0.548 ملجم/كجم إلى 0.551 ملجم/ كجم (0.0006 ملجم/كجم) والزنك 0.218 ملجم/كجم إلى 0.220 ملجم/كجم ؛ (0.0006 ملجم/كجم) الكادميوم والرصاص لم يسجلا أي قراءة لخضار الخيار . النحاس 0.164 ملجم/كجم إلى 0.168 ملجم/كجم ؛ (0.0006 ملجم/كجم) والزنك 0.235 ملجم/كجم إلى 0.240 ملجم/كجم ؛ (0.0006 ملجم/كجم) ، الكادميوم والرصاص لم يسجلا أي قراءة لخضار البامية. بناءاً على المعايير القياسية المأخوذه من منظمة الصحة العالمية ومنظمة الزراعة والأغذية العالمية (0.0006 mg/kg) يلاحظ أن تراكيز النحاس والزنك في الخيار والبامية عالية جداً من المعيار العالمي . لذلك يلاحظ أن التلوث في المدى غير المسموح به لتلك العناصر . وتوصلت الدراسة إلى أن التخلص من مخلفات مياه الصرف في مصنع سكر عسلاية وتصريفها في قناة الجاسر والتربة الزراعية يسبب تلوثاً حاداً في القناة والتربة الزراعية وهذا يؤدي إلى تراكم بعض المعادن الثقيلة في القناة المغلقة مما يتطلب إجراء دراسات أضافية وحلول عاجلة ؛ توصي الدراسة بمعالجة مياه الصرف قبل وصولها لمجرى النيل الأبيض وقناة الجاسر والاستفادة منها في الأغراض الزراعية وتربية الحيوان .

كلمات مفتاحية:المغزيات الصغري، مياه الري، البامية والخيار.

Introduction

Traditionally, irrigation water is grouped into various quality classes in order to guide the user to the potential advantages as well as problems associated with its use and to achieve optimum crop production. The water quality classifications are only indicative guidelines and their application will have to be adjusted to conditions that prevail in the field. This is so because the conditions of water use in irrigation are very complex and difficult to predict the suitability of water for irrigation will greatly depend on the climatic conditions, physical and chemical properties of the soil, the salt tolerance of the crop grown and the management practices. Thus, classification of water for irrigation will always be general in nature and application under average use condition Many schemes of classification for irrigation water have been proposal, (FAO ,1979). Classified irrigation water in to three groups based on salinity, sodicity, toxicity and miscellaneous hazards. These general water quality classification guidelines held to identify potential crop production problems associated with the use of conventional water sources. The guidelines are equally applicable to evaluate wastewater for irrigation purposes in terms of their chemical constituents, such as dissolved salt, relative sodium content and toxic ions several basic assumption were used to define the range of values in the guidelines and more detailed information on this is reported by (FAO,1985) .Irrigation water that contains certain ions at concentrations values can cause plant toxicity problems. Toxicity normally leads to impaired growth, reduced yield changes in the morphology of the plant and even its death. The degree of damage depends on the crop, its stage of growth, the concentration of the toxic ion, climate and soil condition. The most common phytotoxic ions that may be present in municipal sewage and treated effluents in concentration enough to cause toxicity are: boron (B) , chloride (CL) and sodium (Na) . Hence the concentration of these ions will have to be determined to assess the suitability of wastewater quality for use in agriculture. A number of elements are normally present in relatively low concentration, usually less than a few mg/L, in conventional irrigation waters and are called trace elements. They are not normally included in routine analysis of regular irrigation water, but attention should be paid to them when using sewage effluents particularly if contamination with industrial wastewater discharge is suspended. These include Aluminium (AL) , Beryllium (Be), Cobalt (Co), Fluoride (F), Iron (Fe), Lithium (Li),Manganese (Mn) Molybdenum (Mo), Selenium

(Se) , Tin (Sn) , Titanium (Ti), Tungesten (W) and Vanadium (V). Heavy metals are a special group of trace elements which have been shown to create definite health hazards when taken up by plants, (FAO, 1985). As humans and domestic animals require several nutrients in addition to those required by plant, these additional nutrient should as be considered in food or feed production and their deficiencies corrected by appropriate inputs. In addition to plant nutrient the elements essential for humans and domestic animals are: cobalt (Co), selenium (Se), Chromium (Cr) and Iodine (I) . Some knowledge of the properties and functions of the plant nutrients is helpful for their efficient management and thus for good plant growth and high yields. Available nutrients in the soil solution can be taken up by the roots, transported to the leaves and used according to their functions in plant metabolism. Nutrients ions are of extremely small size , i.e. like atoms , for example , there are more than 100000 million (K+ Ca) ions within a single leaf cell and more than 1000000 molybdate anions , the micronutrient required in the smallest amount . In general (N and K) make up about 80 percent of the total mineral nutrients in plants; (P,S , Ca and Mg) together constitute 19 percent , while all the micronutrients together constitute less than one percent,(FAO ,2006). The evaluation of quality of irrigation water resulted of find out the causes, relationship of effects among water constituents and level of acceptability. Certain constituents emerge as indicators of quality related problem with sufficient reported experiences and measured responses (FAO, 2013) . The presence of metals in irrigation water also has adverse effects on crop production. Also, high concentration of salts can change the plant nutrients balance in the soil meanwhile some salts are toxic to a certain plants. (Shakoor *etal*,2015*)* and *(* Irfan *et al* ,2014*)* .

Material and methods

The samples of vegetables of this study were collected from two different farms location (A and B) around sugar factory were irrigated with wastewater. (*Assalaya* sugar factory is located in Low rain fall Savanna which comprises 18,5% of the Sudan area with mean annual rain fall ranging from 300 to 800 mm irrigated agriculture rain fed traditional and mechanized forming are practiced this zone).Appropriate quality assurance procedures and precaution were taken to insure the reliability of the results. Samples were carefully handled to avoid cross-contamination. Glassware properly cleaned, and reagent used were of analytical grades Demonizing water was used throughout the study. Reagent-blank determination were used to apply corrections to the instrument reading .For validation of the analytical procedure , repeated analysis of the samples against internationally certified plant standard reference material (SRM) of the national institute of standard technology were used ,and the results were found to lie within ±1% of the certified values.

Reagents

Nitric Acid HNO3 (0.1N). Hydrochloric Acid HCL (3N).Deionized water.

Samples Preparation:

Sub samples (each of 500g) were taken at random from the composite samples (200g) were processed for analysis be the dry. Aching method .The samples were first oven –dried at 105˚C for 24hours. The dried samples were then powdered manually a grinder and were subjected to analysis for their heavy contends. powdered samples (14g each), with three replicate taken for each food item, were accurately weighted and placed in a silica crucible, Few drops of concentrated nitric acid was added to the solid as an aid to aching. (John wiley, 2007).The dry-aching process was carried out in muffle furnace by stepwise increase of temperature up to 550˚C and the sample left to ash at this temperature for 6hours the ash was kept in desiccators and then rinsed with 3N hydrochloric acid. The ash suspension was filtered into 50ml volumetric flask through Whatman NO. (1) Filter paper, and the volume was made up to mark with 3N hydrochloric acid (Sobukola *et al* ,2010).

Standard:

The appropriate salts of the metals namely (Copper, Zinc, Cadmium and Lead) of interest were used to prepare aqueous stock solutions of the metal by dissolution in distilled water or dilute Nitric acid and subsequent dilution with distilled water to 1000 mg / l . Five working standard were prepared in triplicate for each metal by serial dilution of the stock solutions. These blank solutions were aspirated into Atomic Absorption Spectrometry (model 180–30 Hitachi spectrometry). A calibration curve of absorbance vs . Concentration was prepared for each metal and used for determination of metal concentration in the fruit vegetables (Cucumber and Okra) samples.

Determination of heavy metals:

` These heavy metals namely (Pb, Cd, Zn, and Cu) determination was performed by using Atomic Absorption Spectrometry (180-30 Hitachi Spectrometer).The Limit of Detection (LOD) of the analytical method for each metal was calculated as being triple the standard –deviation of a series of measurement for each solution (Sobukola *etal* ,2010).

Statistical analysis:

Statistical analysis of data was carried out using RCBD (Randomized Complete Block Design) programs. A one way analysis of variance (ANOVA) was performed. Differences in mean values were accepted as being statistically significant if $P < 0.05$. (lyman.R ,1993).

Results :

The results of Micro-Nutrients in cucumber samples in (A) farm are shown in table (1) and table (2) below . The concentration of Copper in the samples were obtained in range of 0.548 mg / kg to 0.551 mg / kg the levels were not acceptable limits recommended by the FAO i.e.(0.0006mg/kg) , the concentration of Zinc in the samples were obtained in the range of 0.218mg/kg to 0.220 mg/kg the levels were also not acceptable limits prescribed by the FAO i.e.(0.002mg/kg) and the results were also indicate that the concentration of (Cadmium and Lead) were insignificant due to both of two Micro-Nutrients were not detected .

The Table of Mean (1) in farm (A) of Micro-Nutrients (Cu, Zn, Cd, and Pb) in Cucumber Samples

Replications	Treatments			
	Cu mg/kg	Zn mg/kg	Cd mg/kg	Pb mg/kg
R_1	0.548	0.220	0.00	0.00
R_2	0.548	0.219	0.00	0.00
R_3	0.551	0.218	0.00	0.00
Total (T)	1.647	0.657	0.00	0.00
Mean (X^-)	0.549	0.219	0.00	0.00
Reference value	0.0006	0.002	0.0005	0.0002

The ANOVA Table (2) in farm (A) of Micro-Nutrients

Source of variation	Degree of freedom	Sum of square(SS)	Mean of square(MS)	F-value	Tabular F-value	
Treatment	3	4.84	1.61		5%	1%
Experimental error	8	0.16	0.02	80.0	4.07	7.59
Total	11	4.99	-			

Highly significant at (1%) level significance

The results of Micro-Nutrients in Okra samples in (B) farm are shown in table (3) and table (4) below . The concentration of Copper in the samples were obtained in range of 0.164 mg / kg to 0.168 mg / kg the levels were not acceptable limits recommended by the FAO i.e.(0.0006mg/kg) , the concentration of Zinc in the samples were obtained in the range of 0.235mg/kg to 0.240 mg/kg the levels were also not acceptable limits prescribed by the FAO i.e.(0.002mg/kg) and the results were also indicate that the concentration of (Cadmium and Lead) were insignificant due to both of two Micro-Nutrients were not detected .

The Table of Mean (3) in farm (B) of Micro-Nutrients (Cu, Zn, Cd, and Pb) in Okra Samples

Replications	Treatments			
	Cu mg/kg	Zn mg/kg	Cd mg/kg	Pb mg/kg
R_1	0.167	0.235	0.00	0.00
R_2	0.168	0.236	0.00	0.00
R_3	0.164	0.240	0.00	0.00

Total (T)	0.499	0.711	0.00	0.00
Mean (X^-)	0.166	0.237	0.00	0.00
Reference value	0.0006	0.002	0.0005	0.0002

The ANOVA Table (4) in farm (B) of Micro-Nutrient

Source of variation	Degree of freedom	Sum of square(SS)	Mean of square(MS)	F-value	Tabular F-value	
Treatment	3	3.72	1.24		5%	1%
Experimental error	8	0.08	0.01	124	4.07	7.59
Total	11	3.80	-			

Highly significant at (1%)

DISCUSSION

The results state that the concentrations of Copper and Zinc were highly significant in cucumber samples because Zinc and Copper were high concentration in this cultivating soil (The result were recorded in farms A as follows : Cu^{+2} 2.40 mg/kg , Zn^{+2} 3.00 mg/kg and Cu^{+2} 2.00mg/kg, Zn^{+2} 2.80mg/kg) that cucumber was grew. Furthermore, and due of acidic range of a cultivating soil . The overall results were indicate that the concentration of pH were lower (6.22) which compared with international level (6.50)(Mohammed S ,2016).In heavy rain and humidity region cultivating soil tend to be acidic due to the water was in-fluxed inside cultivating soil layers, this process trend to soluble and transferred the cations such as (Na^+, Mg^{+2}, K^+ ,Ca^{+2}.). However on other side hydrogen ion (H^+) was displaced of these mention above cations, this mechanism was raised the acidic medium of a cultivating soil.(Jens. G, 2000). When nitrogenic fertilizers were added into a soil after that microorganism in a cultivating soil were excreted hydrogen ion that may was raised the acidic of the cultivating soil. Moreover in acidic cultivating soil ammonium ion (NH^+_4) presence on it, that also was raised the acidity of a soil)(FAO ,2006). That was assisted cucumber to absorb these elements, and also soil texture was assisted Zinc and Copper to exist in this type of a cultivating soil (clay and gilt) this reason may was raised the concentration of these elements in cucumber. (Mohammed, 2010). Moreover organic constituents whereas were existed in a small amount in cultivating soil that does not tend to Form chelate ligand. However, this process enable to raise the concentration of Zinc and Copper in a cultivating soil and also cucumber sample.(Mohammed ,2010).The concentration of Zinc element in a cultivating soil increase whereas the concentration of phosphate decrease due to phosphate almost tend to Form with Zinc element Zinc phosphate ($Zn_3(PO_4)_2$) precipitate which is insoluble compounded . Furthermore, phosphorus is own high ability to increase plant growth than Zinc element. Moreover, phosphorus encourage Zinc to form complexes this process may was decrease the concentration of Zinc element in a cultivating soil and cucumber. (Mohammed ,2010).A cultivating soil presence of Calcium Carbonate ($CaCO_3$) tend to convert to alkaline range this may was decrease the concentration of Zinc in a cultivating soil and at the same

time the concentration of cucumber was decreased (Mohammed ,2010). Zinc is the essential as Copper and Cobalt for both animals and humans. A deficiency of Zinc is marked by retarded growth, loss of taste and hypogonadism, leading to decreased fertility, Zinc. Toxicity is rare, but at concentration water up to 40mg/l may induce toxicity (NAS- NRC ,1974). Whenever that the concentration of Zinc element presence in a high level in Cucumber Fruit that may was to transferred to the human body by Food chains and may was caused some different types of diseases such as diarrhea, poisoning , stomachache and Failure in liver tissues(Frank ,1985). Most Copper minerals are relatively insoluble and hence little Copper is available in surface water and ground water due to the extensive use of pesticides sprays containing Copper compounds for agricultural purposes. It is an essential element in human metabolism but . Furthermore, also presence of Copper in a high values rang in Cucumber Fruit this may was transferred to the human body throughout Food chains to cause anemia , diarrhea , kidney Failure , liver diseases and poisoning. (Frank, 1985), whenever that information's were mentioned above that vegetables were not able safe for human consumption. The results state that the concentrations of Copper and Zinc were highly significant in Okra because Zinc and Copper were high concentration in this cultivating soil (The result were recorded in farms B as follows : Cu^{+2} 2.00mg/kg, Zn^{+2} 2.80mg/kg) that Okra were grew. Furthermore, and due of acidic range of a soil. The overall results were indicate that the concentration of pH were lower (6.22) which compared with international level (6.50)(Mohammed S ,2016). In heavy rain and humidity region cultivating soil tend to be acidic due to the water was in-fluxed inside cultivating soil layers, this process trend to soluble and transferred the cations such as (Na^{+}, Mg^{+2}, K^{+} ,Ca^{+2}.). However on other side hydrogen ion (H^{+}) was displaced of these mention above cations, this mechanism was raised the acidic medium of a cultivating soil. (Jens. G ,2000).When nitrogenic fertilizers were added into a cultivating soil after that microorganism in a cultivating soil were excreted hydrogen ion that may was raised the acidic of the cultivating soil.Moreover in acidic cultivating soil ammonium ion (NH^{+}_{4}) presence on it, that also was raised the acidity of a cultivating soil) (FAO ,2006),that was assisted Okra to absorb these elements, and also soil texture was assisted Zinc and Copper to exist in this type of a cultivating soil (clay and gilt) this reason may was raised the concentration of these elements in Okra.(Mohammed ,2010). Moreover organic constituents whereas were existed in a small amount in cultivating soil that does not tend to Form chelate ligand. However, these processes enable to raise the concentration of Zinc and Copper in a cultivating soil and also Okra samples. (Mohammed ,2010).The concentration of Zinc element in a cultivating soil increase whereas the concentration of phosphate decrease due to phosphate almost tend to Form with Zinc element Zinc phosphate ($Zn_3 (PO_4)_2$) precipitate which is insoluble compounded . Furthermore, phosphorus is own high ability to increase plant growth than Zinc element. Moreover, phosphorus encourage Zinc to form complexes this process may was decrease the concentration of Zinc element in a cultivating soil in Okra. (Mohammed ,2010) A cultivating soil presence of Calcium Carbonate ($CaCO_3$) tend to convert to alkaline range this may was decrease the concentration of Zinc in a cultivating soil and at the same time the concentration of Okra was decreased (Mohammed , 2010).Zinc is the essential as Copper and Cobalt for both animals and humans. A deficiency of Zinc is marked by retarded growth, loss of taste and hypogonadism, leading to decreased fertility, Zinc. Toxicity is rare, but at concentration water up to 40mg/l may induce toxicity (NAS- NRC ,1974).Whenever that the concentration of Zinc element presence in a high level in okra Fruit that may was to transferred to the human body by Food chains and may was caused some different types of diseases such as diarrhea, poisoning , stomachache and Failure in liver tissues (Frank ,1985). Most Copper minerals are relatively insoluble and hence little Copper is available in surface water and ground water due to the extensive use of pesticides sprays containing Copper compounds for

agricultural purposes. It is an essential element in human metabolism but . Furthermore, also presence of Copper in a high values rang in Okra Fruit this may was transferred to the human body throughout Food chains to cause anemia , diarrhea , kidney Failure , liver diseases and poisoning. (Frank, 1985), Whenever that information's were mentioned above that vegetables were not able safe for human consumption.

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Using X-ray Spectrometer (XMET5000) to Identify (O+ve, B+ve) Blood Species

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Abstract

The X-ray technique is considered one of the most widespread and useful methods for the determination of presence and quantity of the elements in a given substance. The aim of this study is to identify the elements contained in the blood samples and use of X-ray techniques to identify (O+ve, B+ve) blood groups. Collect 30 samples for every blood from donors for blood group (O+ve, B+ve). Blood was freshly drawn by venous puncture (human) Coagulation was prevention with Na, EDTA- Ethylenediamine Tetra acetic acid. Measurements were made two blood samples by using the X-MET5000 device at a time of three seconds per. The results of this study found that there was a variation in the concentration of elements (Fe, Pb, Mn, Cr, Ni, and Zn) in (O+ve) blood species it was found that the (0.06, 0.03, 0.03, 0.05, 0.01, 0.01) % mg / respectively , and (B+ve) blood species was found that the (0.08,0.02,0.01,0.04,0.01,0.00) % mg / g respectively. There is variation in the concentration of elements (Fe, Pb, Mn, Cr, and Ni) in the blood groups can be distinguished between blood group (O+ve and B+ve) while the value equal in the concentration of Ni is (0.01) % mg / g. The study recommended that the investigating the concentration of elements in the blood groups to identification using different methods technique.

Key wards: ***X-ray, Blood Groups, X-MET5000.***

المستخلص

تعتبر تقنية الأشعة السينية واحدة من أكثر الطرق انتشارًا ومفيدة لتحديد وجود كمية العناصر الموجودة في مادة معينة. هدفت الدراسة لتحديد العناصر الموجودة في عينات الدم باستخدام تقنيات الأشعة السينية لتحديد فصيلة الدم (O+ ve و B+ ve). جمعت 30 عينة لكل فصيلة دم من متبرعين لفصائل الدم (O+ ve و B+ ve)،تم اخذ عينات دم حديثًة بواسطة ثقب وريدي (إنسان) وتم منع التجلط بحمض تيتراسيتيك صوديوم ، تم تطبيق تقنية الأشعة السينية لتحليل بعض عينات الدم ، قيست عينات الدم في نظام الأشعة السينية باستخدام جهاز X-MET5000 في وقت مدته ثلاث ثوان لكل عينة .توصلت الدراسة الى أن هناك تباين في تركيز العناصر (الحديد ، الرصاص ، المنجنيز ، الكروم ،النيكل والزنك) في فصيلة الدم (O +ve) كما وجد أن (0.06, 0.03, 0.03, 0.05, 0.01, 0.01) % ملجم/الجرام على التوالي. و فصيلة الدم (B +ve) وجد أن (0.08,0.02,0.01,0.04,0.01,0.00) %ملجم/الجرام على التوالي. وهناك اختلاف في تركيز العناصر (الحديد والرصاص والمنجنيز والكروم، والنيكل) في فصائل الدم يمكن تمييزه بين فصيلة الدم (O+ ve و B+ ve) بينما القيمة متساوية في تركيز عنصر النيكل في فصيلتي الدم (O+ ve و B+ ve) هي (0.01) % ملجم/الجرام. توصي الدراسة للتحقق من تركيز العناصر في تحديد فصائل الدم باستخدام تقنيات مختلفة.

Introduction :

X-rays were discovered in 1895 by the German physicist Röntgen, and were so named because their nature was unknown at the time. Unlike ordinary light, these rays were invisible, but they traveled in straight lines and affected photographic film in the same way as light. X-rays are of the same nature as visible light, Roentgen showed that these new rays have the ability to penetrate books and thick wooden barriers. [1, 2, 3]. X-rays are a range of the electromagnetic spectrum located between high-energy gamma rays and ultraviolet rays of less energy, and therefore they are invisible rays, because the energy of photons is greater than visible rays a lot of energy, which means that the frequency and wavelength is large and short, we know that X-rays The properties of light themselves are electromagnetic waves that are subject to the properties of diffraction and interference, and they travel at the speed of light, and the only difference is that their wavelengths are shorter than that of ultraviolet rays. [4, 5, 6] . X-rays with energies ranging from about 100 volts to 10 MeV are defined as electromagnetic waves, which differ only from radio waves, light and gamma rays in wavelength and energy. X-rays show a wave nature with a wavelength ranging from about 10 to10 $^{-3}$ nm. According to quantum theory, an electromagnetic wave can be treated as particles called photons or light quanta. Basic properties of photons such as energy, momentum [7, 8]. Ejecting an electron from its atomic orbit by absorbing a light wave (photon) of sufficient energy. The energy of the photon (hν) should be greater than the energy with which the electron is bound to the nucleus of the atom. When an inner orbital electron is ejected from an atom, an electron will move from a higher energy level orbital to a vacant low energy orbital. During this transition, a photon may be emitted from the atom. To understand the processes in the atomic shell [9]. The phases of the photon emission from the atom can be summarized in three phases: The collision of the accelerating electron with the atom works on excitation. The electron goes from a lower energy level to a higher energy level. The electron returns to the lower energy level and photons of light are released. The unit of measure in the X-ray region is angstroms (Å), equal to 10^{-10} m, and x-rays used in diffraction have wavelengths lying approximately in the range 0.5-2.5 Å, whereas the wavelength of visible light is of the order of 6000 Å[5]. X-ray spectroscopy is used to find out the constituent elements of materials, and it can also reveal various information about materials, [8] by exciting the materials with the X-ray spectrum. When the X-rays pass over the material to be analyzed, the energy rays emitted from the radiation are less compared to the energy produced by the fall of the ray on the sample, and this loss in the energy radiation emitted from the sample used in the internal excitation of the atoms of the system. Blood It is a red liquid that flows in the body and makes up 8% of the body weight and the equivalent of four to six liters of blood in a person. This fluid is essential for carrying out the critical tasks of transporting oxygen and nutrients to the cells of the body, and getting rid of carbon dioxide, ammonia, and other waste products. Plus, it plays a vital role in our immune system and keeps our body temperature relatively constant. Blood consists of four basic components of the four thousand components of blood, the most important of which are red blood cells, white cells, platelets and plasma. Red blood cells. Blood groups were discovered at the beginning of the twentieth century by Landsteiner [10]. In the beginning, the human body generally contains 4-6 liters of blood, which in turn consists of a variety of different cells and fluids in which they swim: Red blood cells: They are responsible for

transporting oxygen from the lungs to the rest of the lungs. In the tissues and cells of the body, and in turn, carbon dioxide is delivered to the cells to the lungs. White blood cells: The primary task is to fight inflammation and infection. Platelets work to coagulate and clot blood in the event of injuries and wounds. Plasma is a blood fluid that carries the rest of the blood components in addition to proteins and nutrients to the cells and tissues of the body. Blood is also an important distributor of body heat. The blood also carries nutrients from the gut into the cells and tissues of the body. The remaining 23 feature the protein sequence of RBC a membrane protein [11, 12]. In 1900, Landsteiner showed that people could be divided into three groups (now called A, B, and O) [13]. **ABO** It is considered a blood group system because it is detected on red blood cells and its antigens are easily detected by blood stacking techniques on red cells. However, it is also present in many different tissues and organs, and in soluble form in secretions, and so are often referred to as his to-blood group antigens. [14, 15]. O Positive blood is the blood group within the ABO blood group system. This blood group belongs to group O and is the most common blood group found worldwide. Those with O positive blood can donate blood for all positive blood types, including O positive, A positive, B positive, and AB positive. Carriers of positive blood cannot receive O positive blood in return Positive blood type is extremely valuable where matching supply for the demand has been a constant challenge. However, it is the third most common blood type which is present in about 1 out of 12 individuals. This means an approximately 8.5% of the population has a B positive blood. But, note that not all of the ethnic groups share the same proportions of the B positive blood type. [16]

Materials and Method:

A total of 60 samples of the two blood groups (O^+ve, B^+ve) were collected in a blood container containing 2 ml of donors each of 30 samples. Blood samples were identified in the medical laboratory (Al-Mowasa Health Center) in Al-Hasaheisa city, using a glass slide. Blood was freshly drawn by venous puncture (human) Coagulation was inhibited with Na, EDT- Ethylenediamine Tetraacetic acid is a polycarboxyl molecule which chelates both lead and calcium. It is used in anticoagulant to inhibit coagulation so blood remains in a liquid phase (whole blood) for various laboratory testing such a hematological cell counting and differentials.

First step: Glass slide

Three spaced drops of (anti-A, anti-B, anti-D) are placed on the glass slide. Add a point of blood to each solution with stirring and slightly flipping. When clusters of anti-A and clusters of anti-B appear, this refers to the AB blood type. If the results contain concentrations of anti-A and did not contain concentrations of anti-B, this indicates the A blood group. If the results contained concentrations of anti-B and did not contain concentrations of anti-A, this refers to blood type B. If the results do not contain concentrations of both anti-A and anti-B, this refers to the blood

type O. If the results contain concentrations of anti-D, this indicates that a positive risus factor, and if no groups of anti-D are given, means that the serotonin factor is negative.



Figure (1) Place three drops of blood on the glass slide in the medical laboratory (Al-Mowasa Health Center) in Al-Hasaheisa city

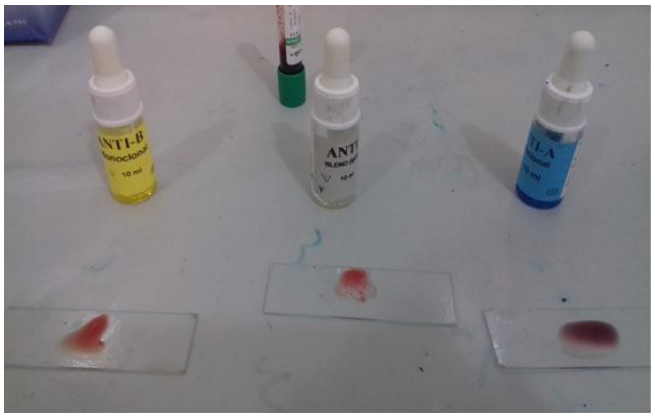


Figure (2) place three drops of (anti-A, anti-B, anti-D) on the glass slide in the medical laboratory (Al-Mowasa Health Center) in Al-Hasaheisa city

Second step: X-MET5000:

This light-weight, handheld EDXRF analyzer provides rapid, non-destructive, point and shoot screening of plastics, PCBs, cables, plastic housings, solder material, fasteners, sheet metal and other electronic components. When used in combination with the powerful user interface it provides information for quick and reliable Go/No-Go decisions. When testing non-uniform components, the X-MET5000 averaging feature will give additional confidence to screening. A fully configurable user interface allows the user to specify alarm limits and testing criteria. Data measured with the X-MET5000 can be easily transferred to a PC for further inspection and report generation. Rapid analysis and reporting avoids delays generally associated with laboratory based analysis, allowing quick screening of a large number of samples. The X-MET5000 can be taken to the sample wherever it is located. It can sort PVC and Br or Sb containing plastics in seconds and helps to support the Waste Electrical and Electronic Equipment (WEEE) recycling. Industries with high reliability exempt applications, like aerospace, medical equipment and military systems, may use the X-

MET5000 to ensure the presence of adequate lead in their product components, especially in finishes and solder joints for reasons of product safety and reliability as Show in fig (3) **[17]**



Figure (3) X-MET5000



Figure (4) Measuring elements in blood samples by XMET- 500 device in the laboratory of the Petroleum Center Technical in Sudan

Results :

Table (1) Sample of blood group (O + ve)

No	Elements concentration %											
	Fe		Pb		Mn		Cr		Ni		Zn	
	%	STD	%	STD	%	STD	%	STD	%	STD	%	STD
1	**0.03**	0.020	**0.02**	0.014	**0.00**	0.006	**0.03**	0.025	**0.01**	0.003	**0.00**	0.00
2	**0.10**	0.002	**0.12**	0.001	**0.00**	0.000	**0.05**	0.033	**0.01**	0.001	**0.00**	0.00
3	**0.04**	0.015	**0.01**	0.009	**0.00**	0.002	**0.03**	0.012	**0.01**	0.004	**0.00**	0.002
4	**0.05**	0.002	**0.02**	0.001	**0.00**	0.000	**0.02**	0.006	**0.01**	0.001	**0.00**	0.002
5	**0.04**	0.012	**0.01**	0.003	**0.01**	0.010	**0.06**	0.007	**0.01**	0.001	**0.00**	0.002
6	**0.02**	0.002	**0.02**	0.014	**0.01**	0.002	**0.02**	0.000	**0.01**	0.003	**0.00**	0.001
7	**0.05**	0.011	**0.02**	0.007	**0.00**	0.000	**0.02**	0.001	**0.01**	0.000	**0.00**	0.000
8	**0.05**	0.018	**0.02**	0.002	**0.00**	0.000	**0.04**	0.029	**0.00**	0.000	**0.00**	0.001
9	**0.04**	0.018	**0.02**	0.012	**0.00**	0.000	**0.03**	0.000	**0.01**	0.001	**0.00**	0.001
10	**0.04**	0.012	**0.01**	0.003	**0.01**	0.010	**0.06**	0.007	**0.01**	0.001	**0.00**	0.002
11	**0.06**	0.007	**0.01**	0.012	**0.00**	0.002	**0.03**	0.021	**0.01**	0.001	**0.00**	0.000
12	**0.21**	0.132	**0.02**	0.005	**0.00**	0.000	**0.17**	0.009	**0.00**	0.000	**0.00**	0.005
13	**0.00**	0.003	**0.01**	0.010	**0.04**	0.060	**0.02**	0.000	**0.00**	0.000	**0.00**	0.006
14	**0.04**	0.055	**0.03**	0.012	**0.17**	0.246	**0.02**	0.001	**0.01**	0.014	**0.00**	0.005
15	**0.12**	0.064	**0.02**	0.029	**0.19**	0.037	**0.02**	0.001	**0.00**	0.000	**0.02**	0.024
16	**0.04**	0.003	**0.01**	0.003	**0.01**	0.012	**0.03**	0.000	**0.01**	0.000	**0.00**	0.000
17	**0.05**	0.070	**0.02**	0.005	**0.16**	0.086	**0.02**	0.000	**0.00**	0.000	**0.00**	0.002
18	**0.09**	0.001	**0.02**	0.024	**0.00**	0.000	**0.02**	0.000	**0.01**	0.014	**0.00**	0.000
19	**0.07**	0.002	**0.03**	0.038	**0.00**	0.000	**0.02**	0.001	**0.00**	0.000	**0.00**	0.000
20	**0.09**	0.125	**0.01**	0.011	**0.00**	0.000	**0.02**	0.001	**0.00**	0.000	**0.00**	0.000
21	**0.12**	0.012	**0.01**	0.007	**0.00**	0.000	**0.02**	0.000	**0.00**	0.000	**0.00**	0.000
22	**0.03**	0.047	**0.00**	0.003	**0.03**	0.036	**0.15**	0.015	**0.00**	0.000	**0.00**	0.000
23	**0.11**	0.036	**0.14**	0.017	**0.02**	0.019	**0.07**	0.001	**0.00**	0.001	**0.00**	0.003
24	**0.08**	0.033	**0.01**	0.010	**0.01**	0.016	**0.02**	0.000	**0.02**	0.018	**0.01**	0.008
25	**0.00**	0.002	**0.00**	0.004	**0.06**	0.000	**0.08**	0.092	**0.02**	0.015	**0.00**	0.000
26	**0.10**	0.028	**0.11**	0.020	**0.00**	0.000	**0.05**	0.003	**0.00**	0.000	**0.00**	0.000
27	**0.00**	0.001	**0.02**	0.025	**0.00**	0.000	**0.09**	0.010	**0.01**	0.002	**0.01**	0.002
28	**0.02**	0.035	**0.03**	0.025	**0.11**	0.097	**0.12**	0.151	**0.01**	0.014	**0.00**	0.000
29	**0.13**	0.177	**0.01**	0.011	**0.00**	0.000	**0.02**	0.001	**0.00**	0.003	**0.00**	0.004
30	**0.10**	0.035	**0.01**	0.002	**0.00**	0.000	**0.02**	0.000	**0.00**	0.000	**0.00**	0.007
Total average	**0.06**		**0.03**		**0.03**		**0.05**		**0.01**		**0.001**	

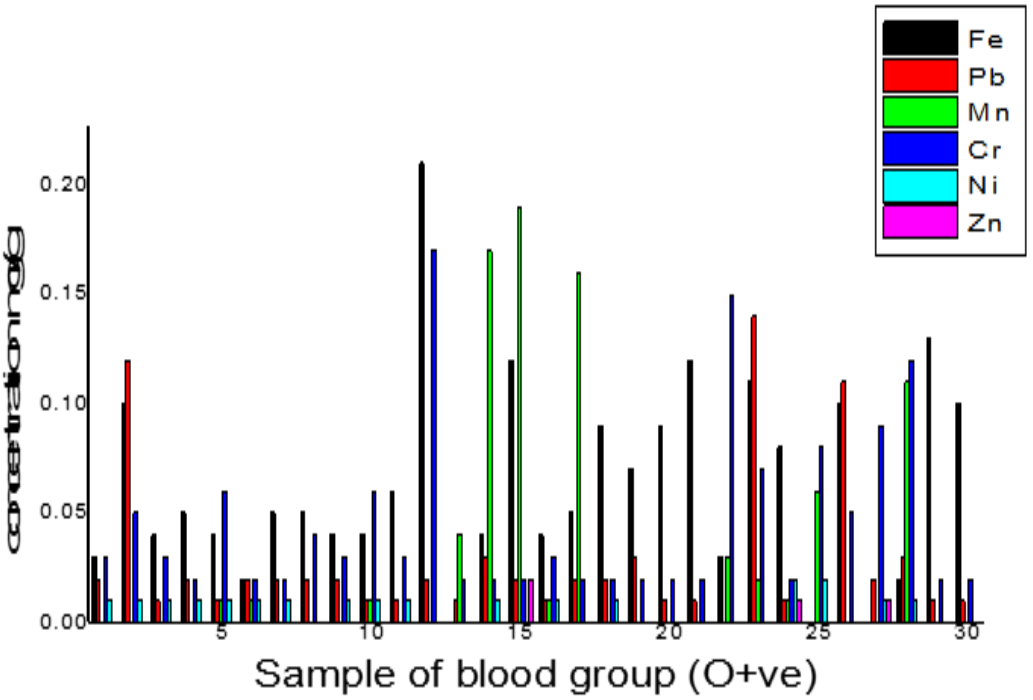


Figure (4) shows the concentration of elements in the blood sample of a group (O^+ ve)

Table (2): Sample of blood group (B+ve)

No	Elements concentration %											
	Fe		Pb		Mn		Cr		Ni		Zn	
	%	STD	%	STD	%	STD	%	STD	%	STD	%	STD
1	0.13	0.026	0.08	0.009	0.01	0.010	0.06	0.015	0.01	0.002	0.00	0.002
2	0.19	0.005	0.01	0.003	0.01	0.012	0.06	0.006	0.01	0.002	0.00	0.000
3	0.13	0.012	0.00	0.003	0.00	0.005	0.05	0.019	0.00	0.000	0.00	0.001
4	0.19	0.032	0.12	0.011	0.01	0.007	0.05	0.023	0.01	0.002	0.00	0.001
5	0.11	0.014	0.06	0.010	0.01	0.010	0.05	0.012	0.01	0.001	0.00	0.001
6	0.16	0.036	0.01	0.002	0.02	0.002	0.05	0.015	0.01	0.001	0.00	0.001
7	0.10	0.018	0.01	0.004	0.01	0.006	0.05	0.018	0.01	0.001	0.00	0.002
8	0.13	0.020	0.00	0.004	0.01	0.003	0.05	0.020	0.01	0.001	0.00	0.001
9	0.04	0.011	0.03	0.004	0.00	0.000	0.04	0.013	0.00	0.001	0.00	0.000
10	0.04	0.011	0.02	0.007	0.00	0.006	0.02	0.015	0.01	0.001	0.00	0.001
11	0.02	0.015	0.01	0.004	0.02	0.002	0.03	0.012	0.01	0.002	0.00	0.000
12	0.03	0.003	0.01	0.004	0.00	0.000	0.02	0.009	0.00	0.000	0.00	0.003
13	0.04	0.016	0.02	0.002	0.00	0.003	0.03	0.022	0.00	0.000	0.00	0.000
14	0.02	0.006	0.01	0.006	0.02	0.034	0.03	0.021	0.01	0.002	0.00	0.001
15	0.05	0.005	0.02	0.004	0.00	0.009	0.01	0.005	0.01	0.004	0.00	0.000
16	0.03	0.003	0.01	0.008	0.00	0.006	0.02	0.000	0.01	0.001	0.00	0.001

17	0.03	0.006	0.01	0.002	0.00	0.002	0.03	0.024	0.01	0.005	0.00	0.002
18	0.08	0.007	0.01	0.011	0.00	0.001	0.03	0.024	0.01	0.001	0.00	0.001
19	0.04	0.006	0.01	0.004	0.00	0.000	0.03	0.017	0.01	0.000	0.00	0.000
20	0.06	0.008	0.01	0.006	0.00	0.009	0.03	0.020	0.01	0.001	0.00	0.000
21	0.08	0.019	0.01	0.001	0.00	0.000	0.05	0.002	0.01	0.000	0.00	0.001
22	0.06	0.019	0.02	0.003	0.00	0.000	0.02	0.000	0.01	0.001	0.00	0.003
23	0.08	0.009	0.01	0.003	0.02	0.033	0.05	0.003	0.01	0.002	0.00	0.001
24	0.05	0.018	0.01	0.001	0.00	0.000	0.02	0.000	0.01	0.002	0.00	0.000
25	0.07	0.019	0.01	0.006	0.00	0.002	0.04	0.013	0.00	0.001	0.00	0.001
26	0.05	0.067	0.01	0.004	0.00	0.000	0.04	0.009	0.01	0.009	0.00	0.000
27	0.06	0.019	0.01	0.009	0.00	0.001	0.03	0.001	0.00	0.002	0.00	0.002
28	0.06	0.017	0.01	0.008	0.00	0.000	0.03	0.025	0.01	0.003	0.00	0.000
29	0.04	0.025	0.02	0.005	0.00	0.005	0.03	0.013	0.01	0.004	0.00	0.002
30	0.07	0.049	0.01	0.010	0.00	0.000	0.03	0.000	0.01	0.003	0.00	0.000
Total average	0.08		0.02		0.01		0.04		0.01		0.00	

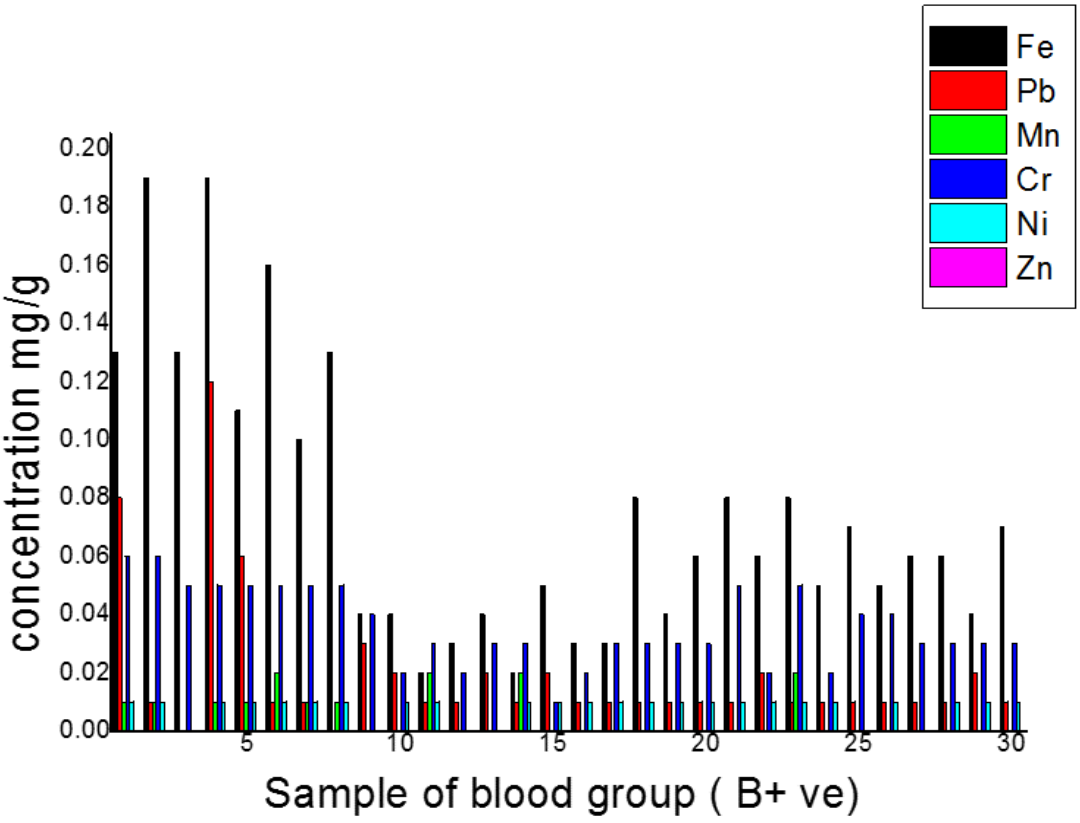


Figure (5) shows the concentration of elements in the blood sample of a group (B+ve)

Discussion:

The measured concentration of elements of the blood samples of group (O + ve) and table (1) shows the concentrations of elements in the samples and the average concentration of each element in all samples. figure (4) shows a comparison between the concentration of the elements in the group (O+ ve) where he found that the highest concentration of iron (Fe) elements 0.06 % mg / g and Chromium (Cr) 0.05 % mg / g and lowest concentration of the element Zinc with an average 0.001 % mg / g, While the values equal in the concentration of the elements Lead (Pb) and Manganese(Mn) 0.03 % mg / g in the blood samples of the group (O+ ve). The measured concentration of elements of the blood samples of group (B+ ve) and table (2) shows the concentrations of elements in the samples and the average concentration of each element in all samples. figure (5) shows a comparison between the concentration of the elements in the group (B+ ve) where he found that the highest concentration of Iron (Fe) elements 0.08 % mg / g and Chromium (Cr) 0.04 % mg / g, the element concentration of Lead (Pb) 0.02 % mg / g .While the values equal in the concentration of the elements Nickel (Ni) and Manganese (Mn) 0.01 % mg / g. No concentration for element Zinc (Zn) was recorded in the blood samples of the group (B+ ve).

Conclusion:

This study shows that there is a variation in the concentration of elements in the blood group (O+ ve and B+ ve) such as Iron, Lead, Manganese and Chromium, while the element of Nickel is equal to (O+ ve and B+ ve) blood groups. The device did not record any concentration of the zinc (Zn).

Recommendation:

The study recommended investigating the concentration of elements in the blood groups to identification using different methods technique.

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Numerical Solution of Ordinary Differential Equations by Heun's Method using MATLAB

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Abstract

The subject of the numerical solution relates to the derivation, description and analysis of methods to obtain numerical solutions to mathematical problems that are difficult to solve by the usual algebraic analytical methods.Heun's method is one of the numeric methods to solve the initial value problems for ordinary differential equations. And the goal of this study solve ordinary differential equations of initial value problem by Heun's method manually and using matlab. We found that the solution of matlab is more accuracy and speed than the manual and the lower the error rate the smaller the h, the accuracy score was 0.0001.

Key Words: ***Initial Value Problem, Approximate solution, Heun's method*** **.**

المستخلص

يتعلق موضوع الحل العددي باشتقاق ووصف وتحليل طرق للحصول علي حلول عددية لمسائل رياضية يصعب عادة حلها بالطرق التحليلية الجبرية المعتادة . طريقة Heun's هي إحدى الطرق العددية لحل مسألة القيمة الابتدائية للمعادلات التفاضلية العادية. والهدف من هذه الدراسة حل المعادلات التفاضلية العادية لمسألة القيمة الابتدائية باستخدام طريقة Heun's, وبإستخدام الحزمة البرمجية MATLAB. توصلت الدراسة أن الحل بال MATLAB هوأكثردقة وسرعة من الحل اليدوي و أن نسبة الخطأ تقل كلما صغرة قيمة h ،حيث كان الخطأ قدره 0.0001.

Introduction:

We commence our exposition of the computational aspects of differential equations by examining closely numerical methods for ordinary differential equations (ODEs).This is important because of the central role of ODEs in a multitude of applications. Not less crucial is the critical part that numerical ODEs play in the design and analysis of computational methods for partial differential equations (PDEs). Thus, even if your main interest is in solving PDEs, ideally you should first master computational ODEs, not just to familiarize yourself with concepts, terminology and ideas but also because (as we will see in what follows) many discretization methods for PDEs reduce the underlying problem to the computation of ODEs **[1]** ,In this study we studied the solution of initial value problems for ordinary differential equations. Because ODEs arise in diverse forms, it is convenient for both theory and practice to write them in a standard form. **[6]**. In this paper we will describe some ways of getting an approximate numerical solution of a first-order Initial Value

Problems $y' = f(x,y), y(x_0) = y_0$. This means being able to calculate approximate values of the solution function y by some process requiring a finite number of steps, so that at the end of this step-by-step process we are reasonably close to the "true" answer. Graphically, we are trying to approximate the solution curve with a simpler curve, usually a curve made up of straight line segments. The very nature of what we will be trying to do contains the notion of error, the discrepancy between a true value and its approximate value. Although there are various ways to measure error, we will focus on absolute error, which is defined by the quantity |true value −approximation|, the absolute value of the difference between the exact value and the approximate value. [3].

Initial value problem:

The general form of a first-order differential equation is

$$y' = f(x,y)$$

Where $y' = \frac{dy}{dx}$ and $f(x,y)$ is a given function. The solution of this equation contains an arbitrary constant (the constant of integration). To find this constant, we must know a point on the solution curve; that is, y must be specified at some value of x, say at $x = a$.We write this auxiliary condition as

$$y(a) = \alpha$$

An ordinary differential equation of order n

$$y^{(n)} = f(x, y, y', \dots, y^{(n-1)})$$

can always be transformed in to n first-order equations. Using the notation

$$y_1 = y, \quad y' = y_2\,, \quad y_3 = y'', \quad \dots\,, \quad y_n = y^{(n-1)}$$

the equivalent first- order equations are

$$y_1' = y_2 y_2' = y_3 y_3' = y_4 \quad \dots \quad y_n' = f(x, y, y_1, y_2, y_3, .. y_n)$$

The solution now requires the knowledge n auxiliary conditions. If these conditions are specified at the same value of x, the problem is said to be an initial value problem. Then the auxiliary conditions, called initial conditions, have the form

$$y_1(a) = \alpha_1 y_2(a) = \alpha_2 y_3(a) = \alpha_3 \quad \dots. \quad y_n(a) = \alpha_n$$

If y_i are specified at different values of x, the problem is called aboundary value problem. **[4]**

On some interval I containing x_0 the problem of solving an n th -order differential equation subject to n side conditions specified at x_0

$$\frac{d^n y}{dx^n} = f(x, y, y', \dots, y^{(n-1)})$$

$$y(x_0) = y_0, \quad y'(x_0) = y_1, \qquad \dots, \qquad y^{(n-1)}(x_0) = y_{n-1}$$

where$y_0, y_1, \dots, y_{n-1}$ are arbitrary real constants, is called an $n\,th$-order initial-value problem (IVP)**.[2]**

Numerical Method

Numerical method forms an important part of solving initial value problems in ordinary differential equations, most especially in cases where there is no closed form solution. We present here the

derivation of Euler's method for generating, numerically, approximate solutions to the initial value problem

$$y'(x) = f(x, y), \quad y(x_0) = y_0. \textbf{ [7]}$$

HEUN'S METHOD: TRAPEZOIDAL METHOD:

Another method of solving a first-order vector differential equation like $y'(t) = f(t, y), \ with \ y(t_0) = y_0$ comes from integrating both sides of the equation.

$$y'(t) = f(t, y), \qquad y'(t)|_{t_k}^{t_{k+1}} = y(t_{k+1}) - y(t_k) = \int_{t_k}^{t_{k+1}} f(t, y)dt$$

$$y(t_{k+1}) = y(t_k) + \int_{t_k}^{t_{k+1}} f(t, y)dt \ with \ y(t_0) = y_0$$

If we assume that the value of the (derivative) function $f(t, y)$ is constant as $f(t_k, y(t_k))$ within one time step $\{t_k, t_{k+1}\}$ this becomes $y_{k+1} = y_k + hf(t_k, y_k) \quad with \quad y(t_0) = y_0$ (with $h = y_{k+1} - y_k$), amounting to Euler's method.

$$y_{k+1} = y_k + \frac{h}{2}\{f(t_k, y_k) + f(t_{k+1}, y_{k+1})\}$$

But, the right-hand side (RHS) of this equation has y_{k+1} which is unknown at y_k. To resolve this problem, we replace the y_{k+1} on the RHS by the following approximation:

$$y_{k+1} \cong y_k + hf(t_k, y_k)$$

so that it becomes

$$y_{k+1} = y_k + \frac{h}{2}\{f(t_k, y_k) + f(t_{k+1}, y_k + hf(t_k, y_k))\}$$

This is Heun's method, which is implemented in the MATLAB routine "ode_Heun()". It is a kind of predictor-and-corrector method in that it predicts the value of y_{k+1} by $y_{k+1} \cong y_k + hf(t_k, y_k)$ at y_k and then corrects the predicted value by $y_{k+1} = y_k + \frac{h}{2}\{f(t_k, y_k) + f(t_{k+1}, y_k + hf(t_k, y_k))\}$at t_{k+1}. The truncation error of Heun's method is $O(h^2)$ while the error of Euler's method is $O(h)$.**[8]**

The next approach Heun's method introduces a new idea for constructing an algorithm to the solve Initial Value Problems

$$y'(t) = f(t, y(t)) \quad over \quad [a, b] \quad with \ y(t_0) = y_0 \qquad (1)$$

to obtain the solution point (t_1, y_1) we can use the fundamental theorem of calculus and integrate $y'(t)$ over $[t_0, t_1]$ to get

$$\int_{t_0}^{t_1} f(t, y(t))dt = \int_{t_0}^{t_1} y'(t)dt = y(t_1) - y(t_0) \qquad (2)$$

Where the antiderivative of$y'(t)$ is the desired function $y(t)$ when equation (2) is solved for $y(t_1)$ the result is

$$y(t_1) = y(t_0) + \int_{t_0}^{t_1} f(t, y(t))dt \qquad (3)$$

Now a numerical integration meth can by used approximate the definite iniegral in (3). If the trapezoidal rule is used with the step size $h = t_1 - t_0$, then the result is

$$y(t_1) \approx y(t_0) + \frac{h}{2}\left(f(t_0, y(t_0)) + f(t_1, y(t_1))\right) \qquad (4)$$

Notice that the formula on the right hand side of (4)involves the yet to be determine value $y(t_1)$. to proceed we use an estimate for $y(t_1)$. Euller's solution will suffice for this purpose. After it is substituted in to (4) the resulting formula for finding (t_1, y_1) is called Heun's method.

$$y_1 = y(t_0) + \frac{h}{2}\left(f(t_0, y_0) + f(t_1, \quad y_0 + hf(t_0, y_0))\right) \qquad (5)$$

The process is repeated and generates a sequence of points that approximate the solution curve $y = y(t)$. At each step Euller's methods is used as a prediction, and then the trapezoidal rule is used to make a correction to obtain the finale value. The general step for Heun's methd is

$$p_{k+1} = y_k + hf(t_k, y_k), \quad t_{k+1} = t_k + h.$$

$$y_{k+1} = y_k + \frac{h}{2}\left(f(t_k, y_k) + f(t_{k+1}, p_{k+1})\right). \qquad (6)$$

Notice the role played by differentiation and integration in Heun's method. Draw the line tangent to the solution curve $y = y(t)$ at the point (t_0, y_0) and use in to find the predicted point (t_1, p_1). Now look at the point at the graph $z = f(t, y(t))$ and the consider the points (t_0, f_0) and (t_1, f_1) where $f_0 = f(t_0, y_0)$ and $f_i = f(t_i, p_i)$ the area of the trapezoid with vertices (t_0, f_0) and (t_1, f_1) is approximate the integral (3) which is used to obtain the final value in equation (5) . **[5]**

Step Size versus Error

The error term for the trapezoidal rule used to approximate the integral in (3) is

$$-y^{(2)}(ck)\frac{h^3}{12} \qquad (7)$$

If the only error at each the step is that given in (7) after Mstep the accumulated erroe for Heun's method would be

$$-\sum_{k=1}^{m} y^{(2)}(ck)\frac{h^3}{12} \approx \frac{b-a}{12} y^{(2)}(c)h^2 = O(h^2).$$ **[5]**

Example :

Use Heun's method to solve the initial value problems

$$y' = \frac{t-y}{2} \quad on\ [0, \quad 3], \quad with\ y(0) = 1$$

Compare solutions for $h = 1, \frac{1}{2}, \frac{1}{4}\ and\ \frac{1}{8}$ the exact solution curve $y(t) = 3e^{-t/2} - 2 + t$ the table bellow given the values for the four solutions as selected abscivias for the step size $h = 0.25$ a sample calculation is

$$f(t_0, y_0) = \frac{0-1}{2} = -0.5$$

$$p_1 = 1.0 + 0.25(-0.5) = 0.875$$

$$f(t_1, p_1) = \frac{0.25 - 0.875}{2} = -0.3125$$

$$y_1 = 1.0 + 0.125(-0.5 - 0.3125) = 0.8984375$$

This iteration continues until we arrive at the last step

$$y(3) \approx y_{12} = 1.511508 + 0.125(0.619246 + 0.666840) = 1.672269.$$**[5]**

Table below: comparison of Heun solutions with different step size for $y' = \frac{t-y}{2}$ over [0, 3], $with\ y(0) = 1$

t_k	y_k $h = 1$	y_k $h = \frac{1}{2}$	y_k $h = \frac{1}{4}$	y_k $h = \frac{1}{8}$	$y(t_k)$ excat
0	1.0	1.0	1.0	1.0	1.0
0.125				0.943359	0.943239
0.25			0.898438	0,897717	0.897491
0.375				0.862406	0.862087
0.50		0.84375	0.838074	0.836801	0.836402
0.75			0.814081	0.812395	0.811868
1.00	0.875	0.831055	0.822196	0.820213	0.819592
1.50		0.930511	0.920143	0.917825	0.917100
2.00	1.171875	1.117587	1.106800	1.104392	1.103638
2.50		1.373113	1.362593	1.360248	1.359514
3.00	1.732422	1.682121	1.672269	1.670076	1.669390

Example :

Use Heun's method to solve the initial value problems using MATLAB

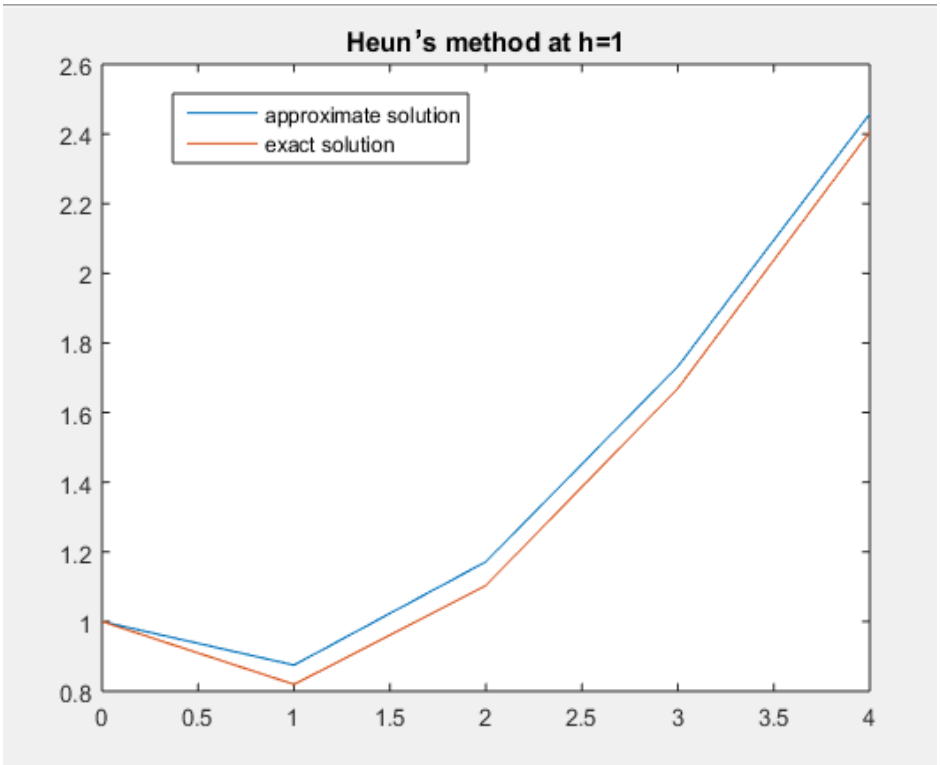
$$y' = \frac{t-y}{2} \quad on\ [0, \quad 3], \quad with\ y(0) = 1$$

Compare solutions for $h = 1, \frac{1}{2}, \frac{1}{4}\ and\ \frac{1}{8}$ the exact solution curve $y(t) = 3e^{-t/2} - 2 + t$

solution

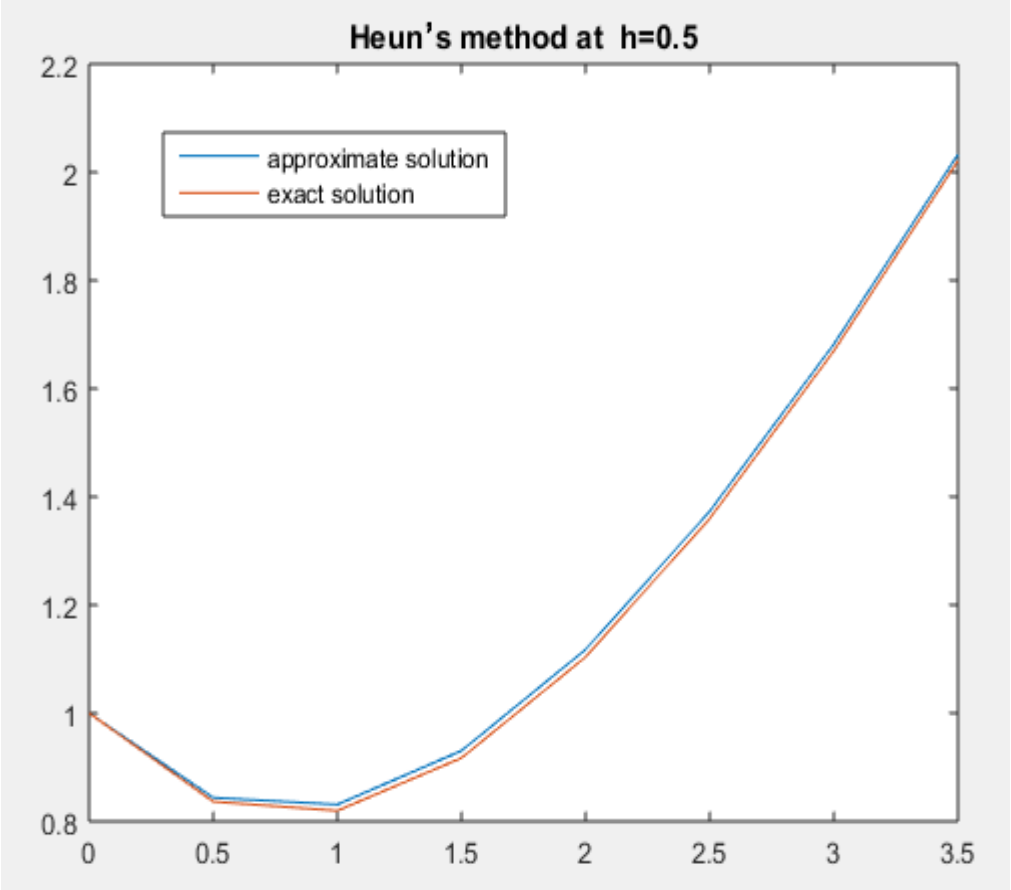
1) at a=0 ,b=3 ,n=3 , $h = 1$,

i	x_i	y_i	real (i)	error (i)
0	0	1	1	0
1.00	1.00000000000000	0.875000000000000	0.819591979137900	0.055408020862100
2.00	2.00000000000000	1.171875000000000	1.103638323514327	0.068236676485673
3.00	3.00000000000000	1.732421875000000	1.669390480445290	0.063031394554711



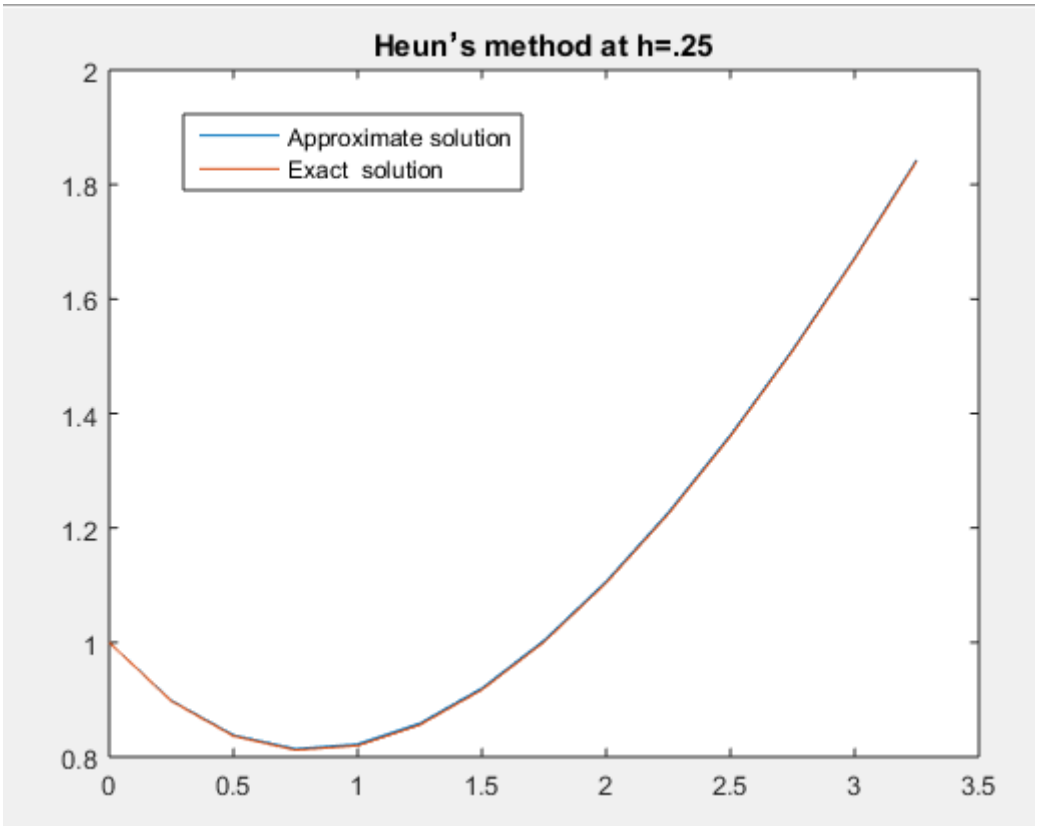
2) at a=0 ,b=3 ,n=6, $h = \frac{1}{2}$

i	x_i	y_i	real (i)	error (i)
0	0	1	1	0
1.00	0.50000000000000	0.843750000000000	0.836402349214215	0.00734765078575
2.00	1.00000000000000	0.831054687500000	0.819591979137900	0.011462708362100
3.00	1.50000000000000	0.930511474609375	0.917099658223044	0.013411816386331
4.00	2.00000000000000	1.117587089538574	1.103638323514327	0.013948766024247
5.00	2.50000000000000	1.373114913702011	1.359514390580570	0.013600523121441
6.00	3.00000000000000	1.682121026329696	1.669390480445290	0.012730545884407



3) at a=0 ,b=3 ,n=12 , $h = \frac{1}{4}$

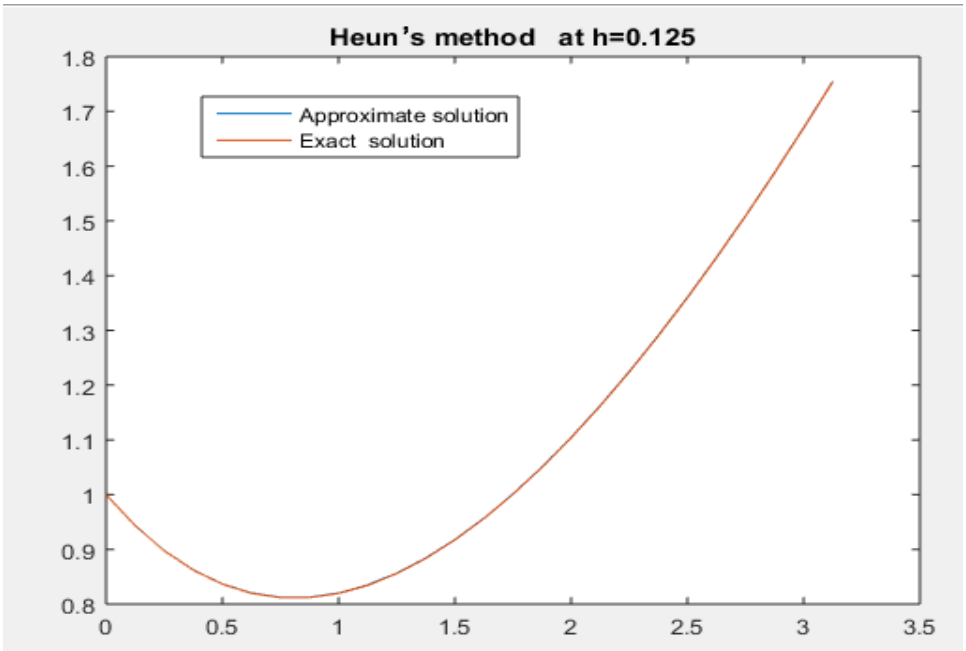
i	x_i	y_i	real (i)	error (i)
0	0	1	1	0
1.00	0.25000000000000	0.898437500000000	0.897490707753787	0.000946792246213
2.00	0.50000000000000	0.838073730468750	0.836402349214215	0.001671381254535
3.00	0.75000000000000	0.814080715179443	0.811867836372916	0.002212878806527
4.00	1.00000000000000	0.822196256369352	0.819591979137900	0.002604277231452
5.00	1.25000000000000	0.858657632576069	0.855784285556971	0.002873347019098
6.00	1.50000000000000	0.920143066258561	0.917099658223044	0.003043408035517
7.00	1.75000000000000	1.003720050681386	1.000586059035525	0.003133991645861
8.00	2.00000000000000	1.106799732242161	1.103638323514327	0.003161408727834
9.00	2.25000000000000	1.227096638620033	1.223957402075049	0.003139236544983
10.00	2.50000000000000	1.362593126281747	1.359514390580570	0.003078735701177
11.00	2.75000000000000	1.511507994295605	1.508518787414239	0.002989206881366
12.00	3.00000000000000	1.672268776214089	1.669390480445290	0.002878295768799



4) at a=0 ,b=3 ,n=24, $h = \frac{1}{8}$

i	x_i	y_i	real (i)	error (i)
0	0	1	1	0
1.00	0.12500000000000	0.943359375000000	0.943239188440427	0.000120186559573
2.00	0.25000000000000	0.897716522216797	0.897490707753787	0.000225814463010
3.00	0.37500000000000	0.862405560910702	0.862087354541201	0.000318206369501
4.00	0.50000000000000	0.836800927339937	0.836402349214215	0.000398578125722
5.00	0.62500000000000	0.820314933692401	0.819846886839925	0.000468046852476
6.00	0.75000000000000	0.812395474816494	0.811867836372916	0.000527638443578
7.00	0.87500000000000	0.812523873802214	0.811945579283676	0.000578294518538
8.00	1.00000000000000	0.820212858005596	0.819591979137900	0.000620878867696
9.00	1.12500000000000	0.835004657618538	0.834348474192769	0.000656183425769
10.00	1.25000000000000	0.856469219364291	0.855784285556971	0.000684933807320
11.00	1.37500000000000	0.884202528348094	0.883494733912823	0.000707794435271
12.00	1.50000000000000	0.917825031514518	0.917099658223044	0.000725373291474
13.00	1.62500000000000	0.956980156559537	0.956241930243240	0.000738226316297
14.00	1.75000000000000	1.001332920517846	1.000586059035525	0.000747861482321
15.00	1.87500000000000	1.050568622595867	1.049816880030397	0.000751742565470
16.00	2.00000000000000	1.104391616149633	1.103638323514327	0.000753292635306
17.00	2.12500000000000	1.162524155015573	1.1161772257730924	0.000751897284650
18.00	2.25000000000000	1.224705309692365	1.223957402075049	0.000747907617315

19.00	2.37500000000000	1.290689949144585	1.289928306133178	0.000741643011407
20.00	2.50000000000000	1.360247784254971	1.359514390580570	0.000733393674401
21.00	2.62500000000000	1.433162469192659	1.432439046187552	0.000723423005107
22.00	2.75000000000000	1.507230757190759	1.508518787414239	0.000711969776520
23.00	2.82500000000000	1.588261707438975	1.587562457286375	0.000699250152601
24.00	3.00000000000000	1.670075939996381	1.669390480445290	0.000685459551091



Program:

```
function r=heuns_method()
f=inline('(x-y)/2');
disp('enter the initial value');
disp('enter the initial condition');
y(1)=input ('y(1)=');
real(1)=y(1);
error(1)=real(1)-y(1);
disp('enter the intervals [a..b]');
a=input('a=');
b=input('b=');
x(1)=a;
disp('enter the value N');
n=input('n=');
h=(b-a)/n;
disp('    ''i''      ''x(i)''    ''y(i) ''real(i)'' ''error(i)');
disp([ 0   a   y(1)  real(1)  error(1) ])
for i=1:1:n+1

y(i+1)=y(i)+(h/4)*(f(x(i),y(i))+(3*f(x(i)+(2*h/3),y(i)+((2*h/3)*f(x
(i),y(i))))));
      x(i+1)=a+(i*h);
            end
```

```
for i=1:1:n+1
    x(i+1)=a+(i*h);
    real(i+1)=(3*exp(-x(i+1)/2))-2+x(i+1);
    %  ((x(i+1))*(x(i+1)))-(.5*exp(x(i+1)));
end
for i=1:1:n
      error(i+1)=abs(real(i+1)-y(i+1));
    disp([ i   x(i+1)   y(i+1)  real(i+1) error(i+1)]);
end
for i=1:1:n+1
x(i)=a+((i-1)*h);
plot(x,y,x,real);
end
```

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Lie Group and Lie Algebra Application in Quantum System

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Abstract

Consider Lie group and Lie algebra have a great role in explaining many concepts in theoretical physics. The aim of the study is finding to clarify the applications of Lie group and Li algebra in a mathematical explanation of some quantum states of electrons such as the angular momentum, spin of the electron and the tensor field that describes the motion of a particle. The study concluded to find mathematical representations of the quantum states of the electron, such as the angular momentum, spin and the tensor field, which describes the electron's spindle motion using Li group and Li algebra.

Key wards: ***Lie group, lie algebra,quantum system, wave function.***

الملخص

يعتبر زمر لي لها دور كبير فى شرح الكثير من المفاهيم فى الفيزياء النظرية . الهدف من الدراسة توضيح تطبيقات زمرة لي وجبر لي فى ايجاد تفسير رياضي لبعض الحالات الكمية للالكترونات مثل العزم الزاوي و اللف المغزلي للالكترون والحقل الممتد الذى يصف حركة الجسيم المغزلية . توصلت الدراسة لتمثيل رياضي للحالات الكمية مثل اللف المغزلي و ايضا وصف الحقل الممتد الذى يصف الحركة المغزلية للالكترون باستخدام زمرة لي وجبر لي .

Introduction:

Consider Lie group and Lie algebra have a great role in explaining many concepts in theoretical physics. In this study we trying explain Li group and Li algebra application in quantum mechanic.

Basic concept

If **H** is a Hilbert space and A ∈ B (**H**) is a non-negative self-adjoint operator on **H**, then it can be shown that A has a well-defined (but possibly infinite) trace. What this means is that the value of

$$\text{Trace(A)} = \sum_j \langle e_i\,,\ Ae_j \rangle$$

is the same for each orthonormal basis $\{e_i\}$ of **H**. Note that since A is a non-negative operator, $\langle e_i\,,\ e_j \rangle$ is a non-negative real number, so that the sum is always defined, but may have the value $+\infty$.

Now, if A is any bounded operator, then $A*A$ is self-adjoint and nonnegative. We say that A is Hilbert–Schmidt if

$$\text{Trace}\ (A^*A) \leq \infty$$

Given two Hilbert–Schmidt operators A and B, it can be shown that $A*B$ is a trace-class operator, meaning that the sum

$$\text{trace}(A^*A) = \sum_j \langle e_i\,,\ A^*Be_j \rangle \qquad (2.1)$$

is absolutely convergent and the value of the sum is independent of the choice of orthonormal basis. We define the Hilbert–Schmidt inner product of A and B and the associated Hilbert–Schmidt norm of A by $\langle A, B \rangle_{HS} = \text{trace}(A^* B)$

Definition 2.1. A Lie group is a set G with two structures: G is a group and G is a (smooth, real) manifold. These structures agree in the following sense: multiplication and inversion are smooth maps.

A morphism of Lie groups is a smooth map which also preserves the group operation:

f(gh) = f(g)f(h), f(1) = 1.

In a similar way, one defines complex Lie groups. However, unless specified otherwise, "Lie group" means a real Lie group. The following are examples of Lie groups

(1) R^n, with the group operation given by addition

(2) $(R^*, \cdot)$

$(R_+, \cdot)$

(3)[$S^1 = \{z \in \mathbb{C} : |z| = 1\}, \cdot]$

(4) GL (n, R) $\subset R^{n^2}$. Many of the groups we will consider will be subgroups of GL(n,R) or GL(n, $\mathbb{C}$).

(5) SU (2) = {A $\in$GL(2, $\mathbb{C}$) | A $\bar{A}^t = 1$, det A = 1}. Indeed, one can easily see that

$$SU(2) = \left\{ \begin{pmatrix} \alpha & \beta \\ -\beta & \bar{\alpha} \end{pmatrix} : \alpha, \beta \in \mathbb{C}, |\alpha|^2, |\beta|^2 = 1 \right\} \quad (2.2)$$

Definition 2.2. An action of a Lie group G an a manifold M is an assignment to each g $\in$G a diffeomorhism $\rho(g) \in$ Diff M such that $\rho(1) = id$, $\rho(gh) = \rho(g)\ \rho(h)$ and such that the map

G ×M $\rightarrow$ M: (g, m) $\rightarrow$ ρ (g).m is a smooth map.

Definition2:3 A Lie algebra G is a vector space over a field k with a bilinear composition law

(x; y) $\rightarrow$ [x; y]

[x, ay + bz] = a[x, y] + b[x, z]

with x, y, z $\in$ L and a, b $\in$ k, and such that

1. [x, x] = 0

2. [x, [y, z]] + [z, [x, y]] + [y, [z, x]] = 0; (Jacobi identity)

Notice that [x, y] = [y, x], since [x + y, x + y] = 0

= [x, y] + [y,x]

Difenition2.4: : Kronecker product for vectors. The Kronecker product (also referred as the tensor product) is a special way to join vectors together to make bigger vectors. Suppose we have the two vectors:

$v = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$ $u = \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$ The Kronecker product is defined as:

$$v \otimes u = \begin{bmatrix} v_1 u_1 \\ v_1 u_2 \\ v_2 u_1 \\ v_2 u_2 \end{bmatrix} \quad (2.3)$$

3-The Lie Algebra of a Matrix Lie Group

We now associate a Lie algebra g to each matrix Lie group G.

Definition 2.1: If G ⊂ GL(n;ℂ) is a matrix Lie group, then the Lie algebra g of G is defined as follows:

g = {X ∈ $M_n(\mathbb{C})$ | e^{tX} ∈ G for all t ∈ R }

That is to say, X belongs to g if and only if the one-parameter subgroup generated by X lies entirely in G. Note that to have X belong to g, we need only have e^{tX} belong to G for all real numbers t.

Proposition 3.1: For any matrix Lie group G, the Lie algebra g of G has the following properties.

1. The zero matrix 0 belongs to g.
2. For all X in g, tX belongs to g for all real numbers t.
3. For all X and Y in g, X + Y belongs to g.
4. For all A ∈ G and X ∈ g we have AXA^{-1} ∈ g.
5. For all X and Y in g, the commutator [X, Y] := XY − YX belongs to g.

Example 3.1: The Lie algebras u(n) and su(n) of U(n) and SU(n) are given by:

U(n) = { X ∈ $M_n(\mathbb{C})$ | X^* = - X }

Su(n) = { X ∈ u(n) | trace(X) =0 }

The Lie algebra of O(n) is equal to so(n)

Finally, the Lie algebra of O(n) is equal to so(n).

Proof. If X^* = −X, then by Property 2 of the above Theorem

$$(e^{tX})^* = e^{tX^*} = e^{-tX} = (e^{tX})^{-1},$$

showing that e^{tX} is unitary. In the other direction, if e^{tX} is unitary for all t ∈ R, then $(e^{tX})^*$ = $(e^{tX})^{-1}$ = $(e^{tX})^{-1}$. Thus, $(e^{tX})^*$ = $(e^{tX})^{-1}$, Differentiating this relation at t = 0, using (16.1), gives X∗ = −X. Thus, the Lie algebra of the first three properties of g say that g is a real vector space. Since $M_n(\mathbb{C})$ is an associative algebra under the operation of matrix multiplication, the last property of g shows that g is a real Lie algebra Prosision (1)For a particle moving in $R^2$the Hamiltonian flow generated by the angular momentum function

J(**x**, **p**) = $x_1\ p_2 - x_2\ p_1$

Consists of simultaneous rotations of **x** and **p**. That is to say,

$$\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} = \begin{bmatrix} \cos t & -\sin t \\ \sin t & \cos t \end{bmatrix} \begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix}$$

$$\begin{bmatrix} p_1(t) \\ p_2(t) \end{bmatrix} = \begin{bmatrix} \cos t & -\sin t \\ \sin t & \cos t \end{bmatrix} \begin{bmatrix} p_1(0) \\ p_2(0) \end{bmatrix}$$

Angular momentum is a particularly useful concept when a system has rotational symmetry, since in that case the angular momentum is a conserved quantity.

Theorem 3.1: (Stone's Theorem) Suppose U(·) is a strongly continuous one-parameter unitary group on **H**. Then the infinitesimal generator A of U(·) is densely defined and self-adjoint, and U(t) = e^{itA} for all t ∈ R. If U(·) is a strongly continuous one-parameter unitary group, then U(·) is continuous in the operator norm topology if and only if the infinitesimal generator of U(·) is a bounded operator .

suggests, most one-parameter unitary groups that arise in applications are not continuous in the operator norm topology.

Before giving the proof of Stone's theorem, let us work out the generator of the group in [let H= L^2 R^n] and let $U_\alpha(t)$ be the translation operator given by

$$(U_\alpha(t)\varphi(x) = \varphi(x + t\alpha)$$

Then U(·) is a strongly continuous one –operator unitary group

Definition 3.2: If G_1 and G_2 are matrix Lie groups, then a Lie group homomorphism of G1 to G2 is a continuous group homomorphism of G_1into G_2. A Lie group homomorphism is called a Lie group isomorphism if it is one-to-one and onto with continuous inverse. Two matrix Lie groups are called isomorphic if there exists a Lie group isomorphism between them.

Example 3.2: The real general linear group, denoted GL(n,R), is the group of invertible n × n matrices with real entries. The groups SL(n,C) and SL(n,R) are, respectively, the groups of complex and real matrices with determinant 1. They are called the special linear groups.

Example 3.3: An n × n matrix $U \in M_n(C)$ is said to be unitary if

$U^*U = UU^* = I$. A matrix U is unitary if and only if

$\langle U_v , U_w \rangle = \langle v, w \rangle$ for all v, w $\in C^n$. The group of unitary matrices is denoted U(n) and called the (n ×n) unitary group. The special unitary group, denoted SU(n), is the subgroup of U(n) consisting of unitary matrices with determinant 1.

DEFINITION 3.3: Orthogonal vectors. We say that two vectors are orthogonal, or perpendicular, if their inner product is 0.

The condition $(U^*U)_{jk} = \delta_{jk}$ is equivalent to the condition that the

Example 3.4:

The vectors $v = \begin{bmatrix} i \\ i \end{bmatrix}$ $u = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$ v·u =0, this implies that v and u are orthogonal i.e

$\langle v , u \rangle = 0$, in quantum mechanics if we determine the quantum state u and v to any particle must be are orthogonal.

Columns of U form an orthonormal set in C_n, as can be seen by direct computation. Geometrically, the condition $U^*U = 1$ is equivalent to the condition that $\langle U_{v_1} , U_{v_2} \rangle = \langle v_1 , v_2 \rangle$ for all v_1, $v_2 \in C_n$, i.e., that U preserves the inner product on C_n, By taking the determinant of the condition $U^*U = I$, we see that $|\det U| = 1$ for all $U \in U_{(n)}$. In this, the finite-dimensional case, the condition $U^*U = I$ implies that U^* is the inverse of U and thus that $UU^* = I$. This result does not hold in the infinite-dimensional case.

Now we have example (3): An n× n real matrix $R \in M_n(R)$ is said to be orthogonal if $R^{tr} R = R R^{tr} = I$. A matrix R is orthogonal if and only if

$\langle Rv , Rw \rangle = \langle v, w \rangle$

for all v, w $\in R^n$The group of orthogonal matrices is denoted O(n) and is called the (n×n) orthogonal group. The special orthogonal group, denoted SO(n), is the subgroup of O(n) consisting of orthogonal matrices with determinant 1.

Comment: the condition $R^{tr} R = 1$ implies that $R R^{tr} = 1$ and that the columns of R from an orthonormal set in R^n Geometrically,

a real matrix R is in O(n) if and only if $\langle Rv_1 , Rv_2 \rangle = \langle v_1 , v_2 \rangle$ for all $v_1 , v_2 \in R^n$ i.e., if and only if R preserves the inner product on $\in R^n$. By taking the determinant of the condition $R^{tr} R = 1$ we see that det R= ±1 for all R ∈ O(n).

4-Tensor representation:

We consider three basic mechanisms for combining representations to produce new representations: direct sums, tensor products, and duals.

Definition 4.1: Suppose (Π_1, V_1) and (Π_2, V_2) are representations of a matrix Lie group G. The direct sum of these two representations is the representation:

$\Pi_1 \oplus \Pi_2 : G \to GL(V_1 \oplus V_2)$ (4-1)

given by $(\Pi_1 \oplus \Pi_2)(A) = \Pi_1(A) \oplus \Pi_2(A)$. (4-2)

The **tensor product** of Π_1 and is the representation

$\Pi_1 \otimes \Pi_2 : G \to GL(V_1 \oplus V_2)$ given by

$(\Pi_1 \oplus \Pi_2)(A) = \Pi_1(A) \otimes \Pi_2(A)$.

Finally, the dual ofΠ_1 is the representation $\Pi_1^{tr} : G \to GL(V^*)$ given by

$\Pi_1^{tr}(A) = \Pi_1(A^{-1})^{tr} = \Pi_1(A^{tr})^{-1}$ (4-3)

Similarly, the direct sum, tensor product, and dual of Lie algebra representations can be defined by

$\pi_1 \oplus \pi_2(X) = \pi_1(X) \oplus \pi_2(X)$

$\pi_1 \oplus \pi_2(X) = \pi_1(X) \oplus I + I \oplus \pi_2(X)$ (4-4)

$\Pi_1^{tr}(A) = -\pi_1(X)^{tr}$ (4-5)

It is important to note the differences in formulas between the group and the Lie algebra in the case of tensor products and dual representations. It is easy to motivate the definitions for the Lie algebra: If G acts on $V_1 \oplus V_2$ by $(\Pi_1 \oplus \Pi_2)(A)$, then the associated Lie algebra action will be given by

$$\frac{d}{dt} \Pi_1 \left(e^{tX} \otimes \Pi_2 e^{tX} \right)\Big|_{t=0} = \pi_1(X) \otimes I + I \otimes \Pi_2(X) \quad (4\text{-}6)$$

Of course, we continue to use this last formula for tensor products of Lie algebra representations, even if there are no associated group representations.

Definition 4.2: A finite-dimensional projective unitary representation of a matrix Lie group G is a continuous homomorphism Π of G into PU(V), where V is a finite-dimensional Hilbert space over C. A subspace W of V is said to be **i**nvariant under Π if for each A ∈ G, W is invariant under U for every U ∈ U(V) such that [U] = Π(A). A projective unitary representation (Π, V) is irreducible if the only invariant subspaces are {0} and V. Given an ordinary unitary representation Σ: G → U(V), we can always form a projective representation, Π : G → PU(V), simply by setting Π = Q ◦ Σ. Not every projective representation, however, arises in this fashion. Thus, considering projective representations gives us more flexibility than considering ordinary unitary representations.

Proposition4.1: Let Π: G → PU(V) be a finite-dimensional projective unitary representation of a matrix Lie group G, and let

π : g → pu(V) be the associated Lie algebra homomorphism. Then there exists a Lie algebra homomorphism σ: g → u(V) such that π(X) = q(σ(X)) for all X ∈ g.

It is possible to choose σ so that trace(σ(X)) = 0 for all X ∈ g, and σ is unique if we require this condition.

That is to say, every finite-dimensional projective representation can be “de-projectivized” at the Lie algebra level. In general, σ is not unique, because there may be σ’s for which trace(σ(X)) is nonzero for some X.

On the other hand, if g has the property that every X ∈ g is a linear

Combination of commentator’s- which is true if g = so(3)- then σ is unique.

If V_1, V_m, and Vn be irreducible representation of so(3) of dimension

2L+ 1, 2m + 1, and 2n + 1, respectively. Suppose that Φ and Ψ are nonzero intertwining maps of V_1,into $V_m \otimes V_n$. Concludes Φ = cΨ for some c ∈ C.

This result is closely related for "irreducible tensor operators."

Angular Momentum operator:

The Hamiltonian generator of rotations [see pro (4.1)] Quantum mechanically, angular momentum is still the "generator" of rotations, meaning that it is the infinitesimal generator of a one-parameter group of unitary rotation operators, in the sense of Stone's theorem . The quantum angular momentum is again conserved in systems with rotational symmetry. This means that if the Hamiltonian ˆH is invariant under rotations, then ˆH commutes with the angular momentum operators, in which case, the angular momentum operators are constants of motion in the quantum mechanical sense. The various components of the classical angular momentum vector for a particle in R^3 satisfy certain simple commutation relations under the Poisson bracket. We will see that those relations are the commutation relations for the Lie algebra so(3) of the rotation group SO(3). If $\widehat{H}$commutes with each component of the angular momentum, each Eigen space for ˆH (the solution space to

$H\psi = \lambda\psi$ for a given λ) is invariant under the angular momentum operators. Thus, the eigenspace constitutes a representation of the Lie algebra so(3). By classifying the irreducible (finite-dimensional) representations of so(3), we can obtain a lot Understanding angular momentum from the point of view of representations of a Lie algebra also prepares us to understand the concept of spin. The Hilbert space for a particle in $R^3$with spin is the tensor product of $L^2(R^3)$ with a finite-dimensional vector space V, where V carries an irreducible action of the rotation group SO(3). In this setting, the proper notion of "action" is a projective representation of SO(3), meaning a family of operators satisfying the relations of SO(3) up to phase factors (constants of absolute value one). These phase factors are permitted because, physically, two vectors that differ only by a constant represent the same physical state. By Proposition (4.1) every projective representation of SO(3) can be de-projectivized at the level of the Lie algebra so(3). Conversely, every irreducible ordinary representation of the Lie algebra so(3) gives rise to a representation of the universal cover SU(2) of SO(3), which in turn gives rise to a projective representation of SO(3). Thus, the possibilities for the space V are in one-to-one correspondence with the irreducible representations of the Lie algebra so(3). In the case of "half integer spin," the space V does not carry an ordinary representation of the group SO(3).

Spin

We begin by looking at the natural action of the rotation group SO(3) on $L^2(R^3)$.

Summary 6.1: (Spin) Each type of particle has a "spin" l, which is a non-negative integer or half-integer. The Hilbert space for such a particle is $L^2(R^3) \otimes V_1$, where V_1 is an irreducible projective representation of SO(3) of dimension 2L + 1.

Since V_1 is finite dimensional, the Hilbert tensor product $L^2(R^3) \otimes V_1$, coincides with the algebraic tensor product of $L^2(R^3)$, with V_L

Definition 6.1: A particle for which the spin is an integer is called a boson, and a particle for which the spin is a half-integer is called a fermion. To see the mathematical spin structure , one needs to look at the structure of the Hilbert space describing multiple particles of a given type, such as the Hilbert space for five electrons.

Definition 6-2: For each R ∈ SO(3), define $\pi(R) : L^2(R^3). \rightarrow L^2(R^3)$ by

$(\pi(R)\psi)(x) = \psi(R^{-1}x)$ (6-1)

Proposition 6.1: For each R ∈ SO(3), the map Π(R) : L^2 (R^3)→ LL^2 (R^3). is unitary. Furthermore, the map Π : SO(3) → U(L^2 (R^3).) is a strongly continuous homomorphism.

. **Proposition 6.2:** For each X ∈ so(3), let π(X) denote the skew-self-adjoint operator such that

$\Pi(etX) = e^{t\pi}$ (X). (6-2)

Then the domain of each $\pi(F_j)$ contains the Schwartz space S(R^3) and on S(R^3) we have the relation

J_j = i $\hbar\pi(F_j)$.

Theorem 5.1: 17.4 Let π: so(3) → gl(V) be a finite-dimensional irreducible representation of so(3). Define operators L^+,L^-, and L_3 on V by :

$L^+ = i\pi(F_1) - \pi(F_2)$

$L^- = i\pi(F_1) + \pi(F_2)$ (6-3)

$L_3 = i\pi(F_3)$.

Let L= $\frac{1}{2}$(dim V- 1), so that dim V= 2L +1. Then there exists a basis

v_0 , v_1, ⋯ v_{2L} of V such that

$$L_3 v_j = (L - J)\, v_j$$

$$L^- v_j = \begin{cases} v_{j+1} & \text{if } j \le 2L \\ 0 & \text{if } j = 2L \end{cases} \qquad (6\text{-}4)$$

$$L^+ v_j = \begin{cases} j(2L + 1 - j)v_{j-1} & \text{if } j > 0 \\ 0 & \text{if } j = 0 \end{cases}$$

Thus, the quantity l completely determines the structure of an irreducible representation of so(3). Since dim V is a positive integer, l has to have one of the following values:

$$L = 0, \frac{1}{2}, 1, \frac{3}{2}, \cdots \qquad (6\text{-}5)$$

If (π, V) is an irreducible finite-dimensional representation

of so(3), then the **spin** of (π, V) is the largest eigenvalue of the operator $L_3 = i\pi(F_3)$. Equivalently, L is the unique number such that dimW =2L+1 Our next result says that all the values of l in (6.5) actually arise as spins of irreducible representations of so(3).

Definition6.3: If (π,V) is an irreducible finite-dimensional representation of so(3), then the **spin** of (π, V) is the largest eigenvalue of the operator $L_3 := i\pi(F_3)$. Equivalently, L is the unique number such that dim V = 2L+1.

Our next result says that all the values of l in (6.5) actually arise as spins of irreducible representations of so(3).

Let W_L and W_M be irreducible representations of so(3) with dimensions 2L+1 and 2M + 1, respectively , the tensor product

space $W_L \otimes W_M$ can be viewed as another representation of so(3). Unless

one of l and m is zero, $W_L \otimes W_M$m is not irreducible. It is of interest, then, to decompose $W_L \otimes W_M$ as a direct sum of irreducible invariant subspaces. This decomposition-in the case that W_L is an irreducible SO(3)-invariant subspace of L^2 (R^3) and W_M is the space of internal degrees of freedom of a particle—will help us in decomposing the Hilbert space for a particle with spin into irreducible, SO(3)-invariant subspaces.

Proposition 6.4 Let π : so(3) → gl(W) be an irreducible representation of so(3). Then there exists an inner product on V, unique up to multiplication by a constant, such that π(X) is skew-self-adjoint for all X ∈ so(3).

Proposition 6.4 17.22 Let $W_{1/2}$ be an irreducible representation of so(3) of dimension 2, and let W_1be an irreducible representation of so(3) of dimension 2L + 1, where l is a non-negative integer or half-integer.

If L = 0, $W_1 \otimes W_{1/2}$ is irreducible. If L > 0, then we have

$$W_1 \otimes W_{1/2} \cong W_{L+1/2} \oplus W_1 - 1/2, \qquad (6.6)$$

where ≅ denotes an isomorphism of representations.

Now, by Proposition (6.3), there exist inner products on Vl and V1/2 that make $\pi_1$and $\pi_{1/2}$ "unitary," meaning that π(X) *= −π(X) for all X ∈ so(3). If we use on $W_1 \otimes W_{1/2}$ the natural inner product, obtained from the inner products on W_1 and $W_{1/2}$, then $\pi_1 \otimes \pi_1$ is also unitary. Thus, the orthogonal complement of the invariant subspace W_0 is also invariant. Since all eigenvalues for J_3 except the largest and smallest have multiplicity 2, we see that the largest eigenvalue for J_3 in $W_0^{\perp}$ is L − 1/2. Let $w_0 \in W_0^{\perp}$ be an eigenvector for J_3 with eigenvalue L −1/2. If we repeatedly apply the lowering operator J^-: $L^- \otimes$I +I $\otimes \sigma^-$ to w_0, we will obtain a chain of eigenvectors of length 2L. These eigenvectors span an irreducible invariant subspace$W_1$of $W_1 \otimes W_{1/2}$ of dimension 2L. Since dim w_0+ dimW_1 = 4L + 2 = dim($W_1 \otimes W_{1/2}$),

we must have $W_1 = W_0^{\perp}$, completing the proof. Since an electron is a "spin 1/2" particle, the Hilbert space for a single electron is,

L^2 (R^3) $\otimes W_{1/2}$, where $W_{1/2}$ is an irreducible projective unitary representation of SO(3) of dimension 2. Meanwhile, in above we saw how to find irreducible, SO(3)-invariant subspaces W_1,f of L^2 (R^3) of dimension 2L + 1, for l = 0, 1, 2, . . . , where f is an arbitrary radial function. By applying Proposition (6.4)to the case W_L, = $W_{1,L}$,, we obtain irreducible SO(3)-invariant subspaces of the Hilbert space L^2 (R^3) $\otimes W_{1/2}$.

$$J_3 = J_3 + \sigma_3 \quad 17.19 \qquad (6.7)$$

where it is understood that L acts on the first factor in the tensor product and σ3 acts on the second factor. (That is to say, the tensor product with the identity operator is understood and thus not written.) Here L_3 is the ordinary angular momentum operator and σ_3 describes the action of the basis element $F_3 \in$ so(3) on the space $W_{1/2}$. Formulas such as (6.7) account for the physics terminology "addition of angular momentum" to describe the analysis of tensor products of representations of so(3). In this context, the operator L_3 = $L_3 \otimes$I) is called an orbital angular momentum operator, and the operator $\sigma_3 =$ (I$\otimes\sigma_3$) is called a spin angular momentum operator, and similarly for $L^{\mp}$ and $\sigma^{\mp}$.

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Create and Develop Intelligent Building Envelope System: An Integrated Design Approach

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Abstract

Advance solutions must be found to reduce environmental impacts and GHG emissions to using mechanical cooling systems to provide thermal comfort, especially in hot-dry regions, like Sudan. This paper introduces PMD as an intelligent and innovative system of building envelope based on cooling functions that are performed by Incorporating envelope techniques like Heat protection techniques (slows heat transfer and prevention or avoidance direct solar radiation), Heat Modulation techniques (Absorbing heat and Storing cold), or Heat Dissipation techniques (Removal heat) (PMD), which are characterize the behavior of the envelope by intelligence to respond to variables external environment. The paper then concluded with a summary of the required advanced building envelope techniques and PMD system as an innovative design solution to improved thermal performance based on understanding heat gain sources.

Keywords: ***Protection, Modulation, Dissipation, avoidance, removal, slowing, shading systems, ventilated facade.***

المستخلص

لابد من إيجاد حلول متطوره للحد من الآثار البيئية وإنبعاثات الغازات الدفيئة الناتجة من استخدام أنظمة التبريد الميكانيكية لتوفير الراحة الحرارية، وخاصة في الأقاليم الحارة والجافة ، مثل السودان. تقدم هذه الورقة PMD كنظام مبتكر وذكي لغلاف المبني بناءً على وظائف التبريد التي يتم إجراؤها بواسطة دمج تقنيات غلاف المبني مثل تقنيات الحماية من الحرارة (إبطاء نقل الحرارة وتجنب الإشعاع الشمسي المباشر) ، أو تقنيات التعديل الحراري (امتصاص الحرارة وتخزين البرودة) ، أو تقنيات تبديد الحرارة (إزالة الحرارة) (PMD) والتي تميز سلوك غلاف المبني بخاصية الذكاء للاستجابة لمتغيرات البيئة الخارجية. ثم أختتمت الورقة بملخص لتقنيات غلاف المبني المطوره المطلوبة و PMD كنظامًا مبتكرًا ومتطورًا لأغلفة المبني لتحسين الأداء الحراري بناء علي فهم مصادر الإكتساب الحراري. تمت مناقشة وتحليل جميع التقنيات والوظائف ومتغيرات البيئة للمساعدة في دمجها في مراحل التصميم المعماري المختلفة.

Introduction:

Integrating building envelop techniques within building design requires analysis and development of technique variables and functions to improve thermal performance, maximize efficiency, and integrate with a building envelope design process. Improving envelop performance requires understanding the relation of techniques to design stages, heat gains forms, and functions performed by techniques, to reach the best and most effective design solutions, that enhance the thermal performance and effectiveness [1]. Therefore, Architects could integrate passive techniques as intrinsic design

elements. Understanding heat gain sources will help maximize the performance of the envelope elements. The incorporation of building envelope techniques, on the hand, to slows heat gain, Avoidance direct solar radiation, Storing low temperature or to remove internal heat, and, on the other hand, perform more than one function will move the environmental design process to a new level to become as whole building envelope design approach and to be a core element in the design stages. The integration of intelligent envelope system in the architectural design process requires many considerations on all levels of design stages. The aim of this integration is to achieve and provide high-efficiency thermal performance. Passive system performances depend mostly on climate conditions. It is, therefore, significant to study and analyze how passive systems interact with natural elements and their relationship to a building site [2]. Intelligence envelope systems, thereafter, need to be integrated within the design process, as their performance requirements are affected by orientation, materials, many variables to maximize their thermal effect, and characteristics of many architectural elements[2]. The main two innovative ideas of this paper are, first, to provide analysis of design solutions based on one or more of these techniques (Heat Protection, Heat Modulation, and Heat Dissipation (PMD)) and, second, to develop a design system based on PMD techniques and analysis of examples of integrated passive systems.

Methods and Martials:

The construction industry becomes heavily dependent on energy to provide the indoor environment with the required thermal comfort, especially in hot climate regions, like Sudan. The building industry became less respectful of the surrounding environment and less dependent on natural or passive techniques. Passive solutions play a major role in improving thermal performance by controlling heat gains and heat dissipation without involving cooling mechanical devices. The performance quality of this approach depends totally on the interaction of the building's design and devices with the surrounding environmental factors, such as sun rays, ambient air temperature, wind, and humidity [3]. Therefore, conducting a thorough analysis of a building's local climatic conditions is essential for any passive cooling approach to successfully fulfill its purpose and to maximize specific functions of PMD. Heat gain sources include internal and external sources. To improve the thermal performance of the building envelope in hot dry climate, it is necessary to study and analyze the forms and thermal loads sources. The thermal loads have three sources, as seen in (Figure 1):

1- Direct heat gain
   - Heat gains caused by solar radiation passing through opaque envelope materials.
   - Heat gain caused by direct sun rays transmitted through windows.
2- Indirect heat gain
   - Heat gains caused by conduction from surrounding environment.
   - Heat gains through convection caused by air infiltration and ventilation exchange.
3- Internal hat gains: by human activities, equipment, and lighting. as seen in (Table. 1)

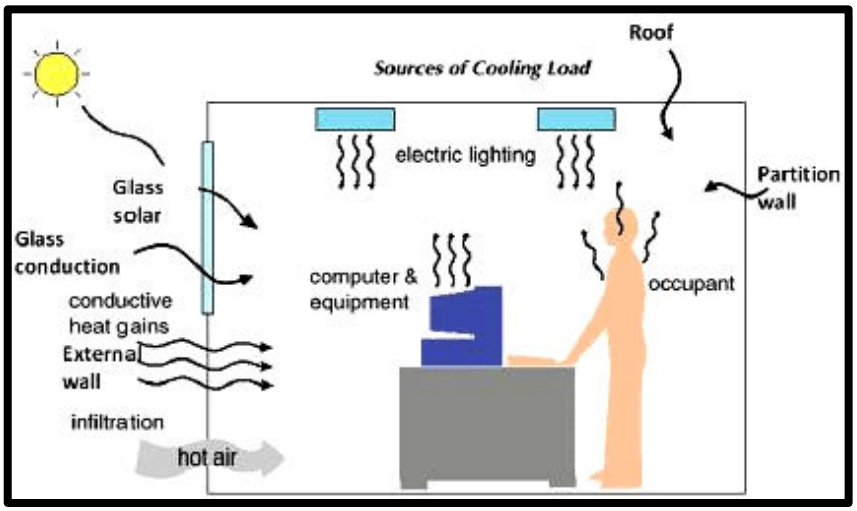


Figure 1. The interaction of the building with the environmental elements [4].

Heat gain type	Direct heat gain		Indirect heat gain		Internal heat gains
Sources	From solar radiation on building envelope materials	From solar radiation on windows and glazed surfaces	By conduction with outdoor environment through building envelope	By convection through the ventilation and infiltration currents	By human activities, equipment, machines, and lighting.

Table 1. Heat gain sources (author).

Building envelope techniques are closely linked to the thermal performance of the building envelope, and it is possible to achieve high-performance building by protection from heat gains, heat modulation, and dissipation the internal heat. In this paper, a detailed review has been made on the various techniques adopted, and studies the possible ways to integrate these techniques to resulted best and most effectiveness solutions. If the building envelope is not in high performance, that will reflect negatively in thermal comfort for occupants. The reason for this is the building envelope can account for a substantial amount of heat gain if not properly designed [5]. The building envelope techniques include the following, as seen in (Figure 2):

Heat Protection technique:

One common challenge for designers in hot dry regions is the reduction of direct radiation heat transfer. The heat reduction technique includes two functions:

- Prevention of direct external solar radiation heat gain.
- Slowing heat transfer from the external climate through the building envelope.

Heat modulation technique:

Thermal energy storage includes functions for storing energy for later use. It may be employed to balance energy demand between day and night. The thermal management of a building could be achieved by two functions.

- Absorption heat during the day and transfers these heats to the ambient at the night.
- Storing of cold mass or air within building envelope.
- Heat dissipation technique: More advanced techniques must therefore be used to heat removal.

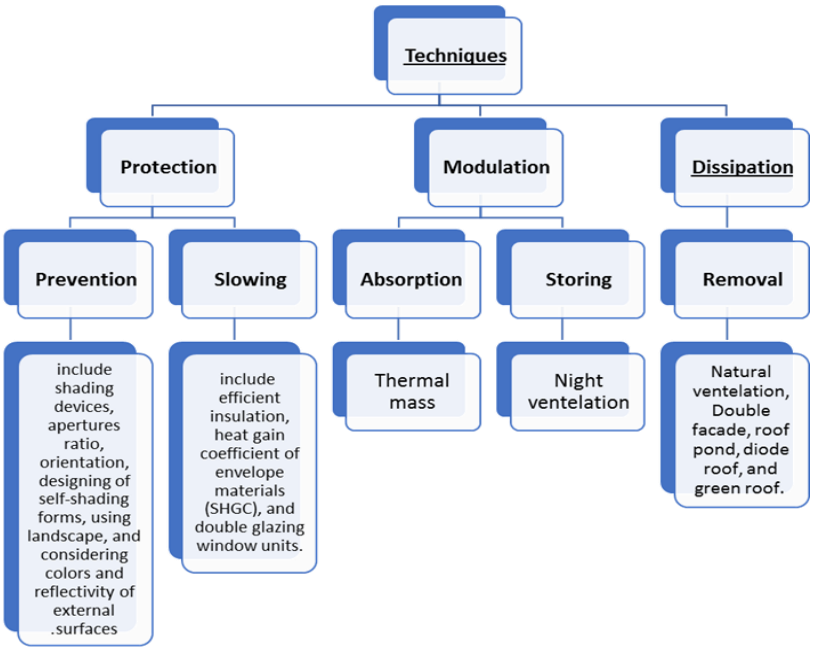


Figure 2. The building envelope techniques (author).

Results and discussions:

Understanding the sources and forms of heat gains are closely linked to the selection process requirements of the heat gain reducing techniques. to make the right decisions to integrate them within the designing process. where it is possible to achieve high-performance building by protecting from heat gains, heat moderation, and removing the internal heat.In this section, the three building envelope techniques, protection, modulation, and dissipation, are discussed in detail concerning the cooling functions and the Incorporating process, focusing on the solutions and variables affecting their performances. Each technique and its functions will be discussed based on the following categories:

- The required conditions of using the techniques.
- The building variables related to the techniques and their functions.

- Conditions climate compatibility.
- Study the integration of techniques and their functions; where some techniques have direct and significant impact on the thermal performance, and some have less direct influence, the level of integration between these techniques and the envelope elements varies among the different types of functions. However, it is important to understand the requirements of the chosen techniques and to make the right decisions to integrate them within the designing process.

Heat Protection technique:

The heat reduction technique includes two functions:

Prevention/Avoidance :

This function refers to all the methods used to Avoid and reduce the amounts of heat gains from direct solar radiation or wind. The key methods of avoidance include different shading systems, apertures ratio, orientation, and considering colors and reflectivity of external surfaces. all these solutions can help to protects the building from direct heat gains. There are several different ways to avoidance heat gain:

Shading systems:

OLiveira [6] studied the effect of static louver shading tools on east, west, and south facades for various locations on the long dominant cooling seasons. The paper concluded that the shading tool improved the buildings thermal performance of countries with high ambient temperatures seasons and solar radiation. Datta [18] studied the effect of external fixed horizontal louvers on the thermal performance in the buildings by maximizing the shading device system to reduce solar gains during summer and allow them during winter. Designing buildings with the passive approach requires integration of many factors together in the process, such as orientation, shading devices, and building form to improve thermal performance as a whole as seen in Table 2.

Table 2. Shading device variables (author).

Elements	Variables	How to maximize avoidance actions
Types by	Horizontal louvers	Southern windows block high solar angles
	Vertical louvers	East and west windows block low solar angels
	Diagonal or eggcrate	Block low and high angles on east, south, and west directions
	Overhangs, canopy	The depth and height, considering solar noon in summer and winter
Device's variables	Space to depth	Depth-to-spacing ratio to balance between sunrays block and view out
	Material	To reflect or to absorb sunrays

Shading design variables integration to maximize the avoidance function

Hemsath and Alagheband Bandhosseini [7] stated that building form and orientation as early design stages could have a great impact to reduce thermal loads. Authors emphasized on the relation between the building's form, and its performance. Many non-rectangular shapes had been evaluated in terms of self-shading and thermal performance like an L or U shape that can offer solar advantages. Zerefos et al. [8] compared polygonal and prismatic building envelopes to orthogonal building envelopes based on the thermal performance in hot climates. The study showed that prismatic formed buildings gain lower solar than orthogonal forms. Designers can use building's

forms as self-shading approach that shades the outside surface materials, windows, and glazed areas (Table 3). An example of a self-shading building is the library of the University of Nottingham, UK, which was designed with large glazing surfaces. The design was based on using self-shading form to protect inner spaces from direct sunrays.

Table 3. shading design and building form variables. (author).

Element's construct	Concepts	Variables	Notes
Building's elements	Exterior wall tilt angle	Winter and summer solar angle	Studying the maximum and minimum solar angles to determine the optimum tilt angle of the external walls for the building to act as self-shading form
Site's elements	Climate	Hot climates	Self-shading forms for buildings with large glazed surfaces and high requirements of daylighting
		Cold climates	Requires less self-shading forms and increase of the direct heat gains

Slowing:

Slowing is a function refers to the reduction of heat transfer through the building's surfaces by conduction. It depends on the interaction of the building's envelope with the outdoor environment by receiving and absorbing heat and then transferring it to the inner spaces. The performance of slowing as a cooling function depends on many key factors in the building's envelope, such as thermal insulation, apertures ratio, heat gain coefficient of building materials (SHGC), and double glazing. These variables control the amount of heat transfer from outdoor environment to inner spaces. There are several different ways to Slowing heat gain through the building's surfaces by conduction:

Solar Heat Gain Coefficient (SHGC):

Issue of reducing heat gain through the external building Envelope is an-important issue in all climate zone especially in hot climate including Sudan, Where the nature of the hot dry climate characterized by high temperatures in most of the year, which increases rate of heat flux inside the building. Roof and wall are analyzed in the same way. the heat gain is simple transmission based on the inside and outside temperature, and U-value of composite structure; The formula used to calculate heat gain from thermal conduction (outside ambient temperature during the cooling season):

$$Q = U*A*(To-Ti) \quad \ldots\ldots\ldots\ldots\ldots (9)$$

- Q = Sensible Heat Gain. A = Surface Area of Wall or Roof.
- U = Overall U-Value for composite Wall or Roof.
- Ti = Inside air temperature To = Outside air temperature.

Gasmalla [18] studied under hot-dry conditions of Wad-Madani, Sudan. the effect of Solar Heat Gain Coefficient (SHGC) on heat gain amount to the inside space. and that any sector of altered wall or roof components of the value of thermal resistance varies therefore vary depending on the value of its thermal Jump sector overall coefficient of the element.

Heat Modulation technique :

Thermal energy storage includes functions for storing energy for later use. It may be employed to balance energy demand between day and night. The thermal management of a building could be achieved by these two functions:

Absorption:

This function refers to Shifting of heat during day to night for removal, the thermal mass of a building can be achieved either by the use of bulky construction material or by the use of additional energy intensive phase change material in the building system.

Thermal mass in the construction material :

The thermal time constant is used to describe the behavior of thermal masses in building envelopes, and it depends on the heat capacity (Q) and the heat transmission resistance (R). In short it represents the effectiveness of the thermal capacity in a building. TTC is calculated for an area by multiplying heat capacity per unit (QA) by the resistance of heat flow of that area (R):

$$TTC = QA \times R \quad (10)$$

Thermal mass using PCM based systems :

In order to enhance the thermal storage effect of the building fabric, thermal mass with high thermal inertia, such as phase change materials (PCMs), is advised to be used. The PCM can be integrated into the building fabric to enhance the thermal storage effect and improve the thermal comfort for the inhabitants.

Storing :

This function refers to keep cold air or low temperature object away from direct heat sources to be used to cool down interior spaces. Throughout architectural history, and particularly in hot climate regions, devices were developed for this purpose as storage design elements, like courtyards, earth spaces, basements combined with wind towers, thermal masses, and sunken courtyards. For the purpose of this research, courtyards are discussed as one of the most efficient devices in storing cold air during the night by night ventilation.

Courtyard:

Courtyard is an opened space surrounded by rooms with openings on the conjoint wall between the rooms and the courtyard space. Optimizing the passive cooling performance of

courtyards in hot regions depends mainly on how to design an efficient storage space by studying shading patterns, geometrical shape, and thermal mass material.

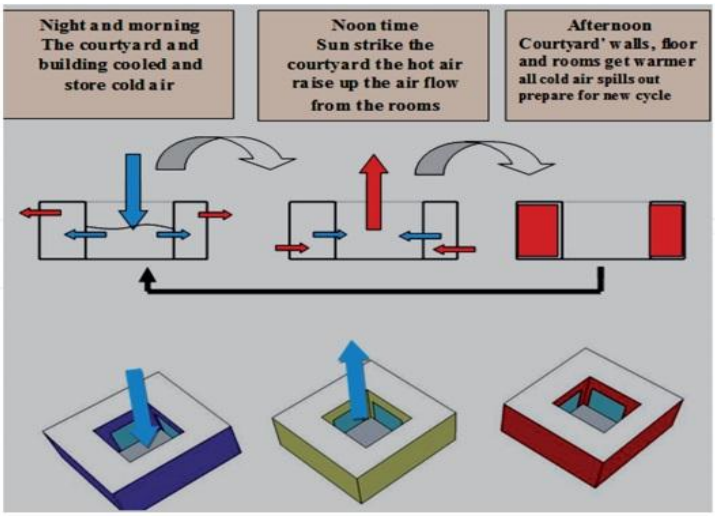


Figure 3. The three periods in the working mechanism of a courtyard (author).

Heat Dissipation technique :

Dissipation is a technique refers to the removal of undesirable gained heat in interior or exterior spaces in a building. This section is to present some experiences on solutions, able to removal of undesirable gained heat in interior spaces in a building. The experiences presented in this paper were selected as the most efficient solutions in hot dry climate, in particular:

Natural ventilation :

They are three principles use air pressure differences due to height, air temperature, or wind speed, to pull air to or from buildings. Therefore, the main concept of passive ventilation design is achieved by maximizing the use of one or more of the three principles in order to induce natural ventilation.

Stack effect:

Stack effect depends on temperature differences to circulate air, as hot air rises up and cool air sinks down (Figure 4). The design for ventilation that depends on stack principles is achieved by letting hot air rise up within spaces, and exhausting it from upper openings, which allows it to be replaced by cooler air from lower openings [11]. The designer's role in the process is represented in designing air movement, which includes the following methods:

- Accelerating the rising of hot air by designing a long vertical space that crosses through the building section, like atriums, or double-skin facades.
- Designing inlet openings for cold air to enter the building from a well-planned and controlled cold space like shaded courtyards or urban spaces, basements, etc.
- Increasing the ventilation process using devices like sunspaces, and skylights in the building's design.

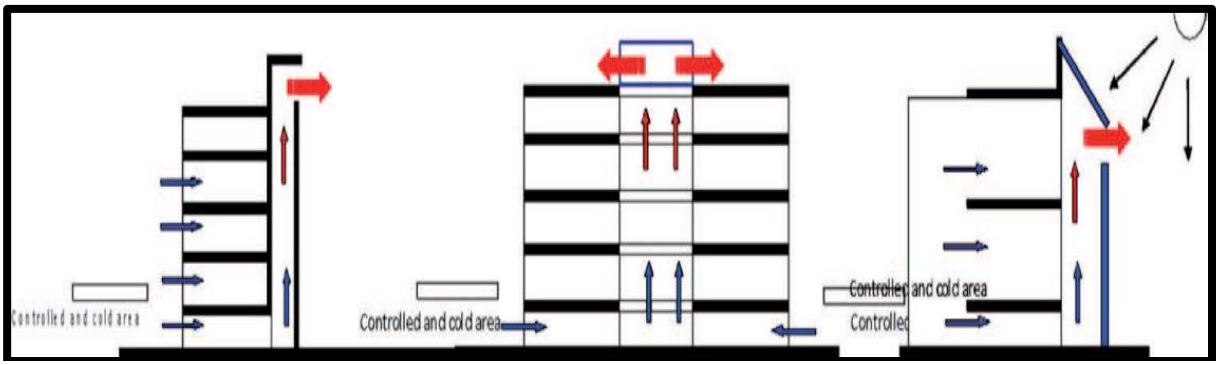


Figure 4. Stack effect [11].

Bernoulli's effect:

Bernoulli's effect depends on air movement around and above buildings creates positive and negative pressures, causing fresh air to be sucked through specific openings into the buildings at the same time allowing hot air to escape though designate openings and locations, as seen in Figure 8. The designer's role in the process is represented in planning and designing air movements with regard to the negative and positive air pressures zones, and it includes the following methods:

- Designing the building's surroundings with the least possible obstructions to allow air flow around, creating the necessary positive and negative pressure zones.
- Designing the building's form to go with the direction of the wind rather than obstructing it; this is to increase wind speed around the building and create positive and negative pressures.
- Designing openings in the areas of positive and negative pressures with integration with the interior space distributions to maximize ventilation process.

Venturi effect:

Venturi effect causes acceleration in air speed when it passes from a wide section area to a thinner section area, developing a negative pressure zone at the thinning points, which help suck the air from near spaces as seen in Figure 8. Designers can make use of this effect in building's designs by:

- Using upper openings in atriums and skylights to improve the performance of the effect.
- Using elements like ventilation ducts and pipes to improve the performance of the effect.

Roof pond:

Roof ponds provide cooling benefits through indirect evaporative cooling and/or radiant cooling [10, 11]. In both processes the roof acts as a heat exchanging element which is cooled by evaporation on its surface. It then functions as a heat sink which absorbs indoor heat and the heat penetrating into the building [12]. Hot dry climates require ascending order of water-concrete insulation thickness, in the summer and in descending order of thickness in the winter. Studies indicate that the indoor temperatures can be maintained below 30°C in summer while the maximum dry-bulb temperatures are above 40°C for hot arid climate of Delhi.

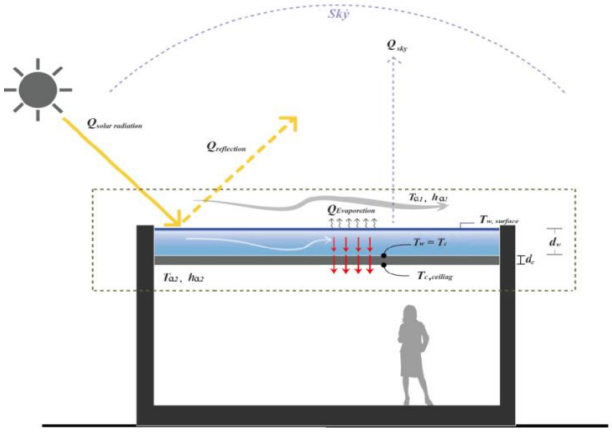


Figure 5. Roof pond system [12].

Double-Skin Façade (ventilated façade)

The interior wall of the DSF system is a thermal-insulating single or double pane glass. Here, low-emittance coatings can be used to reduce radiative heat gain. This layer may have operable casement or hopper windows, or even sliding glass doors. The cavity is an undivided or divided buffer space. It ranges from five to 50 inches in width [13].

Combining of techniques and integration with design process:

Optimizing the performance of building envelope techniques can be achieved by identifying their relation to building design process, where these devices can be implemented and integrated with other architectural and cooling elements to accomplish more than one function. This integration encourages designers to take into consideration the implementation of the techniques and functions as an integrated stage within the designing process, like analysis, planning, and evaluation stages.and strategies in the early stage (analysis) of the design process give the passive cooling an essential part in the design performance values. Considering such strategies as design variables will develop building design and create integrated relations between architectural elements and building envelope techniques. Therefore, find creative solutions for passive cooling, and improve the performance of traditional techniques to be easily practiced in modern designs. In addition, considering cooling performance of a building under the designing process as performance criteria in building design process will help designers reevaluate their decisions on passive cooling performance. To do so, computer simulation software can be used to identify which decisions, devices, and variables need to be reviewed during the evaluation stage. Combining more than one technique or principle of passive cooling in building design requires designers to consider passive cooling strategies in all designing processes. The integrated design will create cooling functions that have a significant and direct impact on building form, plans, sections, and functional distribution, and user's interaction and behavior in the building as seen in (Figure 8). Therefore, an integrated building design approach is needed to make the architectural systems, passive cooling systems, and active systems work together within a complete integrated framework to improve the thermal performance.

Design system:

This paper presents a guideline for implementing building envelope systems by discussing the four passive cooling functions, which designers should take into consideration in the process of creating a building. It discusses the various variables affecting each function within each technique, and it explains in details the major issues that need to be considered for each technique and function in the design stages of building. This integration of passive cooling principles in the design stages

represent a new invention in architectural technology and a guideline of passive cooling design for designers and architects. Table 4 summarizes the required building envelope techniques and design solution that are used to minimize the effects of various heat sources and their implementation considerations in the design stages.

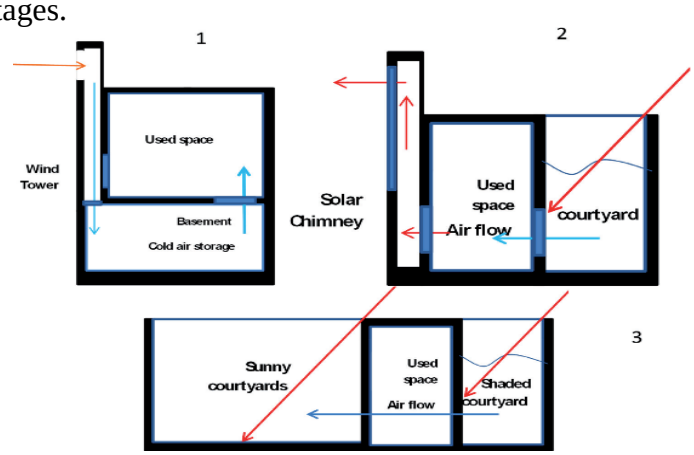


Figure 6. Example of integration of storage devices and removal devices: (1) combining ventilated façade with basement, (2) combining solar chimney with courtyards, and (3) combining two courtyards sunny with shaded one [14].

Table 4. Design system in relation to envelope techniques (author).

heat gain type	Sources	techniques	functions	Solutions
Direct heat gain	From solar radiation on windows and glazed surfaces	Solar and heat Protection techniques	Prevention or Avoidance	-Shading systems Apertures ratio - Self-shading forms. using Landscape- considering colors and reflectivity of external surfaces
	From solar radiation on building envelope materials		Slowing	- Insulation material - envelope materials (SHGC)
		Heat Modulation technique	Absorption	Thermal mass
	By conduction with outdoor	Solar and heat Protection	Prevention	- Shading devices - Reflective materials Orientation design

Indirect heat gain	environment through building envelope	techniques	Slowing	Double glazing
		Heat Dissipation technique	Removal	Implement removal devices
	By convection through the ventilation and infiltration currents	Solar and heat Protection techniques	Prevention	- Controlled ventilation - Ventilation from shaded area
			Slowing	Thermal mass
Internal hat gains	By human activities, equipment, machines, and lighting	Heat Dissipation technique	Remove internal heat	Ventilation
		Heat Modulation technique	Storing cold air	Courtyard
		Solar and heat Protection techniques	Prevention	Design with daylight

Integration design: devices and principles for maximum performance:

The combination of two techniques will be discussed in a way to improve performance, increase efficiency, and integrate techniques with building design. Many techniques can be combined together to perform more than one function and shift cooling and passive design to be as a comprehensive and integrated design approach. The design process of such composite design required multi-dimensional analysis of each function and how it could be integrated with other functions [15].

- Analysis stage: for each device the working mechanism and condition required to perform well should be thoroughly analyzed.
- Design stages: design the techniques to perform more than one function. In addition, design the technique to improve the function of other techniques.
- Performance stage: reevaluate the integration between techniques and architectural systems and how they performed together using experiments or computer simulations.

The following discussion will show how some techniques have been integrated and designed with other techniques to improve their performance and to become as innovative envelope design approaches. The design of wall geometries of the courtyard could help to improve its cooling performance. Freewan [15] showed that the design of wall geometries helps to control direct incident of sunrays on the courtyard's floor, reduce glare, and improve both daylight quality and quantity. It helped to reduce heat gain from artificial light as it introduces daylight from shaded area. The study

showed how wall geometries increase the shading area and time and therefore help to store cold air for long time to ventilate inner spaces with fresh cold air. These configurations as seen in Table 5 improved courtyard design especially in regions with hot and clear sky [16].

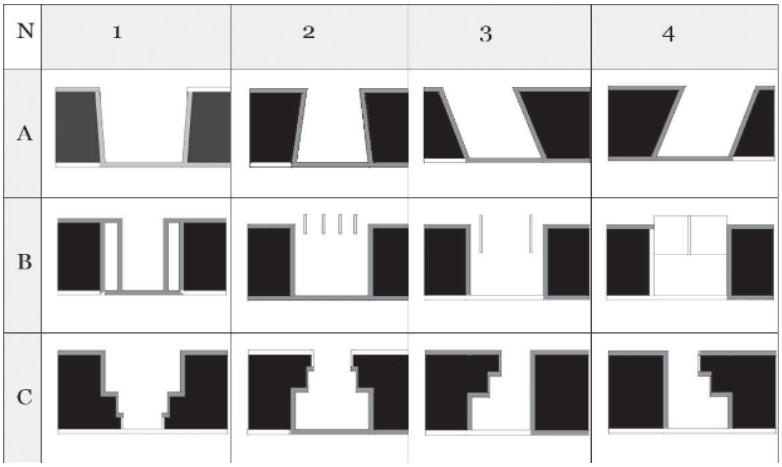


Table 5. Courtyard configurations [16].

Advanced and modern ventilated facade were used in university building at the University of Nottingham to be cooling functions. They were developed to have high level windows to maximize the efficiency. The new ventilated facade was designed in integration with courtyard and building shape. The ventilated facade was used as wind tower, stairs with large glazed area at top part. They were designed with integration with courtyard for maximum performance.The courtyard was designed in integration with movable roof and thermal mass. to solve the noon period problem, when the sun radiation when strikes the courtyard floor and the temperature of air inside the courtyard space starts increasing gradually. can use a movable roof to close at day-time to avoidance the direct sun radiation, for maximum performance.A study [16] has been conducted at Jordan University of Science and Technology to design adjustable shading devices for existing and new buildings in mild climate with hot summer. The research aimed at designing optimized double-positioned external shading device systems that help to reduce energy consumption in buildings and provide thermal and visual comfort during both hot and cold seasons. The design was based on comparison of performance of many variables to determine the best fit characteristics for two positions of adjustable horizontal louvers on south facade or vertical fins on east and west facades for summer and winter conditions. The adjustable shading systems can be applied for new or retrofitted office or housing buildings. The optimized shading devices for summer and winter positions helped to improve thermal performance compared to a base case space with no shading device or with curtains and compared to fix shading devices.Freewan and Abdallah [17] studied integration of many devices to improve ventilation process in university classrooms. The study showed that integration of wind tower with side windows or side horizontal ventilation duct with side windows helped to improve the natural ventilation in classrooms, activate stack effect, and increase the air velocity.Freewan [18] studied how the building's form and wall geometries could help to improve thermal performance. Inward and outward tilted south and north facing facades were studied in the study. Thermal performance was investigated for many inward and outward angles for both south and north directions. The tilted configurations were achieved as an acceptable balance compared to vertical facades to provide best performance. Many variables were monitored and studied like self-shading, time and period of exposure to sun rays, and how the tilted facade performed. The results showed outward tilted facades for the south orientation performed well as they reduced cooling load and improve both daylight quality and quantity (Table 6).

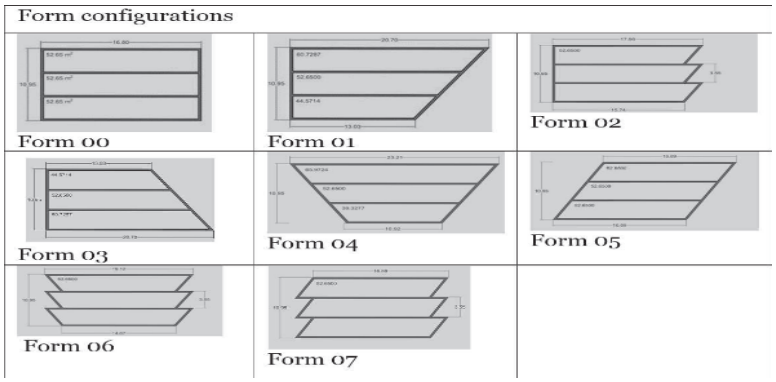


Table 6. Form configurations [30].

ventilated facade as ventilation and heat removing tools was integrated with courtyard or basement to increase airflow rate and bring cold air to be stored. Configurations like these can be found in Iraq and Egypt, which help activate the stack effect to circulate the cold air to the occupied spaces (Figure 7). In modern design wind tower can be integrated with wind tunnel as the wind tower is used to circulate the air, while the tunnel is used to cool the air.

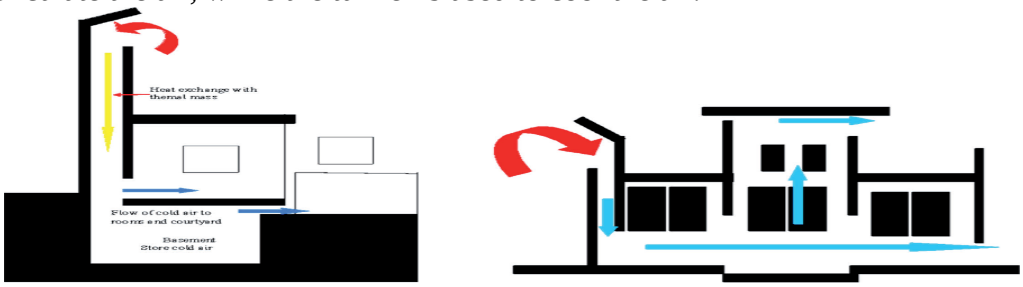


Figure 7. Combining double facade with courtyards and basements (author).

Shading devices and light shelf were studied to be integrated with ceiling geometries in order to maximize thermal performance in hot climate. Many ceiling geometries were investigated to find maximum daylight performance while keeping the optimum shading effects [17, 18].

Pasupathy et al. [18] presented a detailed review on the PCMs' incorporation in buildings, and the various methods used to contain them for thermal management in residential and commercial establishments.Among all the PCM applications for high performance buildings, the PCM integration in wallboards, roof & ceiling, and windows is most commonly studied, due to its relatively more effective heat exchange area and more convenient implementation [19].

Roof ponds were integrated movable insulation tool and water spray. Daytime spraying is desirable when water temperature is significantly above ambient Wet Bulb Temperature (WBT) [19]. Likewise, the case of open roof ponds with water spray, droplet radius of 0.5-1.0 mm and water flow rate of 1.0-1.5 pond volumes per hour are recommended [20]. Simulating cooling performance of roof ponds with movable insulation and continuous water spraying, Erell [20] showed that, compared with conventional air-conditioned buildings with a set-point temperature of 25ºC, higher thermal performance can be achieved when spraying is limited to night time only. Simulation and experimental studies conducted under hot-dry conditions of SdeBoker, Israel, showed that indoor temperature of test room featuring "roof pond with movable insulation and no water spraying" is about 6 ºC lower than that of the control room with bare roof [20].

Conclusions:

This study represented a guideline and innovations in building design process and introduced PMD system as a new level of integration between design solutions and the envelope elements that take into consideration three envelope techniques; protection, modulation and dissipation of heat, and the different functions used for implementing each of the three techniques. The paper then concluded

with a summary of the required building envelope techniques and the design solutions that need to be used to minimize the effects of the various heat sources and the implemented considerations in each of design stages. And to encourage designers to integrate envelope techniques, functions, and solutions in the designing process from early stages of the design while taking into consideration the different variables and requirements concerning the passive functions and their implementation in all design stages.

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Evaluation of Anaesthetic Effects of Three Ketamine Protocols Used for Performing Laparotomy in Donkeys

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ABSTRACT

The anaesthetic effects of three different protocols containing Xylazine, or Detomidine or Romifidine as pre-anaesthetic medications and Ketamine as anaesthetic used for total intravenous anaesthesia (TIVA) were evaluated in 18 donkeys undergoing laparotomy. Donkeys were randomly distributed into three groups each of six animals. Each group was either treated with Xylazine (2mg/kg) or Detomidine (50 µg/kg) or Romifidine (100 µg/kg) intravenously as pre-anaesthetic medication and anaesthetized with an intravenous injection of Ketamine 4 mg/kg and followed by infusion of XKI (xylazine 2.mg/kg and ketamine 6 mg/kg) or DKI (Detomidine 50µg/kg and 6 mg/kg Ketamine) or RKI (Romifidine 100 µg/kg and Ketamine 6 mg/kg) mixed with saline drip. Donkeys anaesthetized with the above mentioned protocols were subjected to laparomy under field conditions. Anaesthetic effects: induction quality, muscle relaxation, phases of anaesthesia and recovery time and quality were also studied. The protocols evaluated in this study reflected good and reliable anaesthetic effects in terms of duration and quality concerning the different stages of anaesthesia monitored in the study. It could be concluded that each of these protocols could be used safely in this species of animals, although poor recovery noticed in the protocol of DKIS may limit its usage or at least dictate close monitoring during recovery to avoid injuries.

Keywords: ***Donkey; Ketamine; TIVA, laparotomy***

المستخلص:

في هذا الدراسة تمت دراسة الآثار التخديرية الناتجة من إستخدام ثلاثة بروتوكولات تخديرية تتكون من عقارات الزايلازين والديتوميدين والروميفيدين والتي أستخدمت كعلاجات تمهيدية إضافة إلى مخدر الكيتامين. أجريت الدراسة على عدد 18 حمار من الحمير البلدية. تم تقسيم الحيوانات عشوائياً الى ثلاثة مجموعات كل واحدة تتكون من 6 افراد. كل مجموعة من الحيوانات تم حقنها بواحد من العقارات التالية عن طريق الحقن الوريدي كعلاج تمهيدي : الزايلازين (2 ملجم/كجم) او الديتوميدين (50 ميكروجرام/كجم) او الروميفيدين (100 ميكروجرام /كجم). عقب العلاج التمهيدي كل فرد من افراد المجموعات الثلاثة تم حقنه بعقار الكيتامين بجرعة 6 ملجم/كجم عن طريق الوريد الذي اعقبه التسريب الوريدي للبروتوكولات (زايلازين 2ملجم/كجم+ كيتامين 6ملجم/كجم) او (ديتوميدين 50 ميكروجرام/ كجم + كيتامين 6 ملجم/كجم) أو بروتوكول (روميفيدين 100 ميكروجرام / كجم + كيتامين 6 ملجم/كجم). تم اجراء عملية فتح البطن في الحمير التي تم تخديرها عاليه وأثناء التخدير تمت دراسة خصائص التخدير المحدث والتي تمثلت في احداث التخدير ونوعيته وارتخاء العضلات واطوار التخدير المختلفة والافاقة من التخدير زمنها

وخصائصها. نتائج الدراسة تشير الى ان كل من البروتوكولات التي تم اختبارها اظهرت اثارا تخديرية جيدة ومقبولة ويعتمد عليها من حيث طول الفترة والخصائص . خلصت الدراسة الى ان اي من البروتوكولات التخديرية التي تم اختبارها يمكن ان تستخدم بفعالية وبدرجة سلامة عالية في هذا النوع من الحيوانات الا ان الافاقة غير الجيدة من بروتوكول الديتوميدين/ كيتامين قد تحد من استخدام هذا البروتوكول او قد تملي على الاقل المراقبة اللصيقة اثناء فترة الافاقة من التخدير لتجنب الاصابات اثناء الافاقة.

INTRODUCTION:

Many surgical procedures in equines are performed under general anaesthesia in order to enhance their accuracy and maximize personal safety. A variety of methods were used for induction of anaesthesia depending on the available drugs, size and condition of the donkeys and familiarity with different protocols. Albozachri *et al*., (2012) recommended two different doses of thiopentone (8 and 12 mg/kg) in combination with diazepam (0.1 mg/kg) as safe protocols to be used in donkeys under field conditions. Thiopentone do not provide analgesia, it should be used with an effective sedative/opioid premedication. As thiopentone tend to induce fatal apnoea in donkeys (Radi *et al.*, 2012), respiration must be carefully monitored. Ketamine (3mg/kg)-Xylazine (1.5 mg/kg)-diazepam (0.1, 0.2, and 0.3 mg/kg) was reported to induce safe anaesthesia and acceptable quality of induction, muscle relaxation and recovery in donkeys under field conditions (Abakar *et al.*, 2014). Combinations of guaifenesin with thiopental or ketamine have been used successfully in donkeys; however, these should be used with caution (Matthews and van Dijk, 2004). Donkeys appear to be more sensitive to guaifenesin; donkeys will become recumbent with approximately 60% of the dose required to produce recumbency in horses (Matthews *et al*., 1997). Donkeys tend to metabolize ketamine more rapidly than horses do, so the combination of guaifenesin-ketamine-xylazine (GKX or triple drip) commonly used in horses may not work well in donkeys (Matthews and van Dijk, 2004). There for this study aims to evaluate three different anaesthetic protocols of ketamine in terms of their anaesthetic effects and safety.

Materials and Methods:

Place of the study:

This study was carried out at the College Farm, Faculty of Veterinary Medicine, Al Butana University, Sudan.

Experimental Animals:

A total of 18 healthy local breed donkeys, 12 males and 6 females were used in this study, they were divided into three equal groups. Their age was between 3-5 years with average body weight of 90±10 kg. The animals were kept in closed pens in the place of the study throughout the duration of the study. They were fed on green fodder, hay and supplemented with concentrates with

free access to water. The animals were kept for two weeks to get acclimatized before starting experiments.

Handling:

Protective bedding made of empty sacks and sandy ground was used to protect the animals during induction, maintenance of anaesthesia, surgery and during recovery.

Drugs:

1. Ketamine Hcl 5% (Troika pharmaceuticals Ltd Thol-382728 Gujarat, India).This drug was used as anaesthetic.

2- XylazineHcl 2% (CevaTiergesundheitb GmbH- Kanzlerstr. 4-40472 Dusseldor)

3- Detomidine 1% (Orion pharma.13483-2).

4- Romifidine 1% (Boehringer InglheimVetmedicaGmbhBlinger 173 55216 Inglheim).

Anaethetic protocols:

The following anaesthetic protocols were evaluated in this study:

1- Xylazine 2% (2mg/kg) + Ketamine 5% (4mg/kg) + infusion with saline drip containing Xylazine 2% (2mg/kg) + Ketamine 5% (6 mg/kg).

2- Detomidine 1% (50µg/kg) + Ketamine 5% (4mg/kg) + Infusion with saline drip containing Detomidine 1% (50µg/kg) + Ketamine 5% (6mg/kg).

3- Romifidine 1% (100µg/kg) + Ketamine 5% (4mg/kg) + Infusion with saline drip containing Romifidine 1% (100µg/kg) + Ketamine 5% (6mg/kg).

Anaesthetic phases scales:

Quality of anaesthesia:

Table (1): Criteria for scoring the quality of anaesthetic induction, muscle relaxation and recovery.

Score	Quality	Character
Induction quality		
1	Smooth	Gradual falling to the ground with no paddling and no stiffness of limbs
2	Fair	Gradual falling to the ground with mild paddling and no stiffness of limbs
3	Rough	Gradual falling with vigorous paddling and strong stiffness of limbs

Muscle relaxation		
1	Excellent	Complete relaxation (jaws, neck, abdomen and limbs)
2	Good	Relaxation of neck, abdomen and limbs
3	Poor	Rigidity in muscles of jaws, neck, abdomen and limbs
Recovery		
1	Smooth	Donkey capable of standing at first attempt - mild ataxia
2	Fair	Donkey remained calm and needed two- three attempts to stand - clear ataxia
3	Poor	Donkey remained calm but assisted to stand
4	Very poor	Donkeys excitement during recovery - assisted and supported

Table (2): Criteria for scoring the quality of abdominal muscle relaxation during performance of surgery.

Abdominal muscle relaxation during performance of surgery		
1	Excellent	Complete relaxation of abdominal muscles
2	Satisfactory	Partial relaxation of abdominal muscle do not prevent surgical procedure
3	Poor	Rigidity of muscles, prevent surgical procedure
4	Normal	Muscles regained normal tonocity

Body muscle relaxation was assed subjectively as follows: jaws muscle relaxation by opening and closure of the jaws, neck and abdomen muscle was assessed by gentle pressure on neck and abdominal muscles and limb muscle relaxation was assessed by flexion and extension of the limbs.

Definitions and monitoring of anaesthetic phases:

Induction of anaesthesia: Was considered subjectively as the period taken by the animal to fall to the ground, showed signs of unconsciousness, respond negatively to painful stimuli and paddling and stiffness of limbs stopped if it present.

Analgesia phase: Was assessed subjectively as the period during which the animal shows signs of unconsciousness and responds negatively to noxious or painful stimuli (pinprick in the perineal and scrotal region).

Lateral recumbency phase: Was considered subjectively as the duration at which the animal respond positively to painful stimuli, muscles regained their tonicity and the animal is incapable of adopting sternal position.

Sternal recumbency phase: It was considered subjectively as the period during which the animal could adopt sternal recumbancy without falling to lateral recumbancy and without adopting standing position (Ghurashi *et al*., 2008).

Standing phase: It is the stage at which the animal stood but unable to walk ten steps (Ghurashi, 1999).

Recovery: The animal was considered to be recovered from anaesthesia when it is capable of supporting itself in standing position and walk for ten steps without falling down (Ghurashi *et al.*, 2008).

Total recovery time:

Total recovery time was considered as the total time calculated from the time of induction of anaesthesia until recovery was attained (Nuha, 2004).

Analgesia during surgery:

Was taken subjectively as the duration of time from induction of anaesthesia untill the animal respond by moving of limbs and raising of head as a result of surgical interference.

Statistical analysis:

T- Test was used to compare data between the different anaesthetic phases. GraphPad Prism 5.0 (GraphPad Software) was used to perform these analytical operations. A descriptive statistics value (percentage) was used to compare subjective data (i.e. induction, analgesia, muscle relaxation and recovery).

Surgical laparotomy:

Standard method for performing laparotomy was used in this study according to the following steps:

- The skin was incised for approximately 10-15 cm in the right flank region.
- The time elapsed from anaesthesia induction up to skin incision was 4- 6 minutes.
- Time for incision of muscles 6-8 minutes after induction of anaesthesia.
- Time for start suturing of muscles 20-33 minutes after induction of anaesthesia
- Time for finishing suturing of muscles 26-38 minutes after induction of anaesthesia.
- Time of starting suturing of skin 28- 41 minutes after induction of anaesthesia.
- Time for finishing suturing of skin 32- 46 minutes after induction of anaesthesia.

Results:

Quality of anaesthetic induction and recovery

Induction quality resulted from the protocols of (XKIS, DKIS and RKIS) ranged between smooth and fair Table (3)

Table (3): Induction quality as a result of using XKIS, DKIS and RKIS.

Scale	Smooth		Fair		Rough	
Protocol	No.	%	No.	%	No.	%
XKIS	4	66.6%	2	33.3%	00	00
DKIS	2	33.3%	4	66.6%	00	00
RKIS	2	33.3%	4	66.6%	00	00

- XKIS=Xylazine/Ketamine/Infusion with performing laparotomy
- DKIS= Detomidine/Ketamine/Infusion with performing laparotomy
- RKIS= Romifidine/Ketamine/Infusion with performing laparotomy

Using either XKIS, DKIS or RKIS to perform laparatomy resulted in smooth and fair recovery in animals subjected to XKIS and smooth recovery in case of using RKIS. Poor recovery was observed in the group of animal anesthetized with DKIS Table (4).

Table (4): Quality of recovery resulted from using XKIS, DKIS and RKIS for the performance of laparotomy.

Scale	Smooth		Fair		Poor		Very poor		Total animal
Protocol	No.	%	No.	%	No.	%	No.	%	No.
XKIS	2	33.3	4	66.6	0	00	0	00	6
DKIS	0	00	2	33.3	4	66.6	0	00	6
RKIS	6	100	0	00	0	00	0	00	6

XKIS= Xylazine/Ketamine/Infusion +Surgery

DKIS= Detomidine/Ketamine/Infusion +Surgery

RKIS= Romifidine/Ketamine/Infusion +Surgery

No. = Number of animals

Using XKIS, DKIS and RKIS together with performance of surgery resulted in almost similar results on abdominal muscle relaxation. Usage of XKIS resulted in excellent and satisfactory muscle relaxation up to 40 minutes from induction of anaesthesia. Usage of DKIS resulted in excellent muscle relaxation in the whole group of animals at the beginning of surgery and at 10 minutes after induction of anaesthesia. Excellent and satisfactory muscle relaxation was also observed to occur up to 40 minutes. Similarly, usage of RKIS resulted in excellent and satisfactory muscle relaxation at the beginning of surgery. Ten minutes after induction of anaesthesia the whole group of animals exhibited excellent muscle relaxation. After 40 minutes from induction of anaesthesia excellent, satisfactory and normal muscle relaxation occurred at equal percentages, Table (5)

Table (5): Effects of induction and maintenance of anaesthesia with XKIS, DKIS and RKIS during performance of lapratomy on abdominal muscle relaxation.

Protocols	XKIS				DKIS				RKIS			
Time	E	S	N	P	E	S	N	P	E	S	N	P
0	66.6	33.4	-	-	100	-	-	-	66.4	33.4	-	-
10	100	-	-	-	100	-	-	-	100	-	-	-
20	66.4	33.4	-	-	66.4	33.4	-	-	66.4	33.4	-	-
30	33.4	33.4	33.4	-	66.4	33.4	-	-	66.4	33.4	-	-
40	33.4	33.4	33.4	-	66.4	33.4	-	-	66.4	33.4	-	-
50	-	-	100	-	-	-	100	-	-	-	100	-

E= Excelent, S= Satisfactory, N = Normal, P=Poor

XKIS= Xylazine/Ketamine/Infusion +Surgery

DKIS= Detomidine/Ketamine/Infusion +Surgery

RKIS= Romifidine/Ketamine/Infusion +Surgery

Zero time= time of starting of surgery

10=10 minutes after induction of anaesthesia

Different anaesthetic phases:

Analgesia phase in the group of DKIS protocol was found to be significantly longer ($p \leq 0.05$) than the duration of analgesia phase resulted in XKIS and RKIS. The duration of analgesia phase and the analgesia depth resulted from using of each of the three protocols was found to be enough to perform surgery in the whole group of animals used in the study. Lateral recumbancy phase resulted from induction and maintenance of anaesthesia with DKIS was found also to be significantly longer ($p \leq 0.05$) compared with the duration of lateral recumbancy phase resulted in XKIS and RKIS protocols. Sternal recumbancy phase duration occurred of using RKIS was found to be significantly shorter ($p \leq 0.05$) than the duration of the same phase resulted from using XKIS and DKIS. Standing phase resulted from using DKIS for induction and maintenance of anaesthesia was found to be significantly longer ($p \leq 0.05$) compared to the duration of the phase recorded as a result of using XKIS and RKIS.

The total recovery time duration observed to occur as a result of using DKIS was found to be significantly longer ($p \leq 0.05$) compared to the duration of the total recovery time resulted from using XKIS and RKIS Table (6).

Table (6): Duration of the different anaesthetic phases (min.) following of induction and maintenance of anaesthesia with XKIS, DKIS and RKIS and performing laparotomy in donkeys

Phase	Analgesia	Lateral recumbancy	Sternal recumbacy	Standing and walking time	Total recovery time
XKIS	36.67±2.58ab	36.00 ± 4.73 a	11.00 ± 0.89a	6.67 ± 2.73a	58.00 ± 7.89a
DKIS	39.33 ±2.58 b	63.97±9.81 b	15.67 ±3.65a	20.83 ±2.04b	100.7 ± 4.59b
RKIS	31.33 ±2.60 a	38.17 ±4.58 a	6.33 ±3.60b	7.00 ±5.36a	49.00 ± 6.75a

- Different letters in the same column indicate significant difference ($p \leq 0.05$).

Discussion:

In this study three anaesthetic protocols were evaluated for their safety and efficacy in performing laparotomy in donkeys. The three protocols used (XKIS, DKIS or RKIS) resulted in smooth and fair induction. Since Ketamine is reported to have no muscle relaxation effect or even it might cause muscle spasm or tonic clonic seizers (Hall *et al.*, 2001), the smooth and fair induction may be

attributed to theα2-adrenocepter agonist used as preanaesthtic medication (Xylazine, Detomidine and Romifidine) which reported to have good muscle relaxation effect (Freeman *et al.*, 2002, Thakur *et al*., 2011, and Amin and Najim, 2011). The quality of recovery resulted from using XKIS and RKIS ranged between smooth and fair. Quality of recovery resulted from using DKIS ranged from fair to poor. Poor recovery observed in DKIS may be due to usage of Detomidine which reported to have longest duration of action (Yamashita *et al*., 2007) and the longest duration of ataxia among the alpha 2 adrenoceptor agonists (Hamm *et al.*, 1995, and England *et al*., 1992). Prolongation in the different phases of anaesthesia observed in case of DKIS whether it is significant or non significant could be attributed to the higher affinity of Detomidine to the receptors which translated in prolongation of the duration of action of Detomidine compared to Xylazine and Romifidine (England and Clarke, 1996, and Bueno, 1999). Also the exaggerated effect of Detomidine which appear in the different phases excluding the analgesia phase may be due to the longest ataxic effect of Detomidine compared to Xylazine and Romifidine as reported by Hamm *et al.*, (1995), and England, (1992). The three protocols were found to have either excellent or satisfactory abdominal muscle relaxation during surgery. The degree of abdominal muscle relaxation recorded was found to be enough in terms of quality and durations for lapratomy as indicated by the satisfaction of the surgeons. Since Ketamine was reported to have no positive effect on muscle relaxation or even sometimes it leads to muscle rigidity (Hall *et al*., 2001), so the muscle relaxation occurred here in this study may be attributed to the muscle relaxing effect of the premedications used (Greene and Thurmon, 1988; Ali, 2013.and Freeman *et al*., 2002).

Conclusion:

We concluded that each of these protocols could be used safely in this species of animals although poor recovery noticed in the protocol of DKIS may limit its usage or at least dictate close monitoring during recovery to avoid injuries.

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Evaluation of Anti-tuberculosis activity of some Sudanese medicinal plants

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Abstract

The study aims at Evaluating Anti -*tuberculosis* activity of some Sudanese medicinal plants .Also, one of the Objectives of the Research is to assess the anti-tuberculosis activity of some Sudanese medicinal plant extracts against standard bacteria , To verify the activity of the active extracts against *Mycobacterium tuberculosis* clinical isolates and To compare the activity with reference antibiotics used. The present Research was carried out to effect know Anti -*tuberculosis* activity of some Sudanese medicinal plants**.** The investigation was carried out on 202 pulmonary tuberculosis specimens from human, obtained from Kassala hospital in 2014 to 2016.The positive specimens were cultured on Löwenstein-Jensen 'L.J.' medium. Eighteen(13%) pure positive mycobacterial **.** Seven (39%) specimens were identified. The seven isolates were treated with Methanol extract of *Argemone mexicana* (Khashkhash asfar) leaves and seeds, Chloroform extract of *A. mexicana* leaves, and Aqueous extract of *Aristolochia bracteolata* (Umm Gala'gel) seeds. The Minimum Inhibitory Concentration (MIC) results revealed that *A. mexicana* extracts had low MICs less than 12.5mg/ml for the most isolates . The MIC of extracts of *A. bracteolata* ranged between >12.5-100mg/ml**.**

Key word: ***Anti- tuberculosis, Aqueous extract, Chloroform extract, Methanol extract, Meicinal plant.***

المستخلص

هدفت هذه الدراسة إلى تقييم فعالية بعض النباتات الطبية السودانية ضد الميكروب المسبب للدرن. ايضا من اهداف البحث تقييم فعالية بعض مستخلصات النباتات الطبية السودانية ضد البكتيرية القياسية ،والتأكد من فعالية المستخلصات ضد الميكروبات

المعزولة ومقارنة الفعالية مع المضادات الحيوية المستخدمة.أجريت هذه الدراسة علي (202) عينة مأخوذة من مرضي يشتبه في إصابتهم بميكروب داء السل الرئوي وجمعت العينات من مستشفي كسلا في الفترة من2014 م حتى2016م. زرعت العينات الموجبة للصبغة علي وسط (Löwenstein–Jensen media) ، كان عدد العينات النامية ثمانية عشر عينة (13%). تم التعرف علي سبع عينات (39%) من التي تسبب داء السل الرئوي . عوملت العزلات السبعة بأوراق وبذور الخشخاش الأصفر المستخلصة بالميثانول، أوراق الخشخاش الأصفر المستخلصة بالكلوروفورم ومستخلص بذور أم جلاجل المائي، حدد أقل تركيز مثبط لنمو البكتيريا, وجد أن أكثر مستخلص نباتي فعال وله أقل تركيز مثبط لنمو البكتيريا هو مستخلص نبات الخشخاش الأصفر (MIC>12.5مج/مل)و مستخلصات نبات أم جلال مابين (MIC100–12.5>مج/مل).

كلمات مفتاحية: مضاد ميكروب السل، المستخلص المائي، مستخلص الكلورفورم، مستخلص الميثانول، النباتات الطبية.

Introduction:

Tuberculosis is a infectious disease and has been considered as a major health problem with 95% cases and 98% death from very ancient time. This is occurring in developing countries including India(Yelmate *et al.,* 2015).India bears almost 25% of the global tuberculosis (TB) burden with an estimated 2,800,000 new cases in 2016(WHO, 2017). Limiting the transmission of TB in the community is critical to curbing the spread of TB. Transmission of TB takes place mostly within the household, but also outside(Sophie *et al.,* 2018). The alarming rise of multi-drug-resistant (MDR), extensively drug-resistant (XDR) and currently, totally drug resistant(TDR)*M. tuberculosis* strains, which are difficult to control with the currently available essential anti-tubercular drugs on the market, and the increased incidence of TB associated with viral infections such as HIV, natural products have proved to be the most prolific and diverse source of antibiotics including some of those used for the treatment of TB. Current studies have indicated the urgent need for the development of new, safe and efficacious drugs to help reduce the global burden of tuberculosis. have recently complicated the chemotherapeutics of tuberculosis (Nguta *et al.,* 2016). Thus, the search for new drugs with Novel mechanisms of action against *M.tuberculosis* is urgently needed .Historically, Novel anti-mycobacterial scaffolds from natural products have recently been reported. Natural products of plant biodiversity have received considerable attention as potential anti-TB agents since they are a proven template for the development of new molecules against tuberculosis. Many anti-tubercular compounds that may prove to be useful leads for TB drug discovery have been derived from medicinal plants (Nauta *et al*., 2015b). *Argemone Mexicana* Linn is an exotic weed indigenous in South America but has widespread distribution in many tropical and sub-tropical countries including West Africa.It is an herb with brances, yellow flowers and yellow juice and commonly known Mexican poppy and found widely throughout India(Yelmate *et al.,* 2015).The Republic of Sudan is the largest country on the African are divided between five geographic regions Eastern, Western, Southern, Northern and Central Sudan which includes the Capital Khartoum. It has high burden of tuberculosis (TB) with a prevalence of 209 cases per 100,000 of the population and 50,000 incident cases during 2009(WHO ,2010). The estimated adult HIV prevalence of 1.5% remains lower than that of its African neighbors to the south and a report from 2002 suggested 4% of tuberculosis patients were co-infected with HIV(Ghada *et al.,* 2016).

Materials and Methods:

Plant materia:

The plants used in this study were collected between July and October2015 from Delta Elgash Bank (Kassala State). They were authenticated by the researcher Yahia Suliman, Medicinal and Aromatic plants and Traditional Medicine Research Institute (MAPTMRI). Voucher specimens were deposited at the herbarium of the institute. leaves and seeds of both *Argemon mexicana* and *Aristolochia bracteolata* were[used]

Preparation of the extracts:

Extraction was carried out according to method described by Sukhdev *et al.* (2008):

Specific weight of each plant sample was coarsely powdered using mortar and pestle. Coarsed sample were successively extracted with chloroform and methanol using soxhelt extractor apparatus. Extraction carried out for about six hours for chloroform and eight hours for methanol till the colour of the solvents at the last siphoning time became colorless. Solvents were evaporated under reduced pressure using rotary evaporator apparatus. Finally extracts exposed to air in Petri dishes till completely dried and the yield percentages were calculated as following: Weight of extract obtained / weight of plant sample X100

Antimycobacterial testing:

Evaluation of antimycobacterial activity was carried out as a susceptibility test of *M.tuberculosis*on LJM following the proportional method as described in Din-Norm 58, 943, part 8(1996).In short, extracts, were dissolved in Dimethyl sulfoxide(DMSO) and added to the medium before heating at 85^0C for 35 min. Test tubes containing the medium were inoculated with a strain of *M. tuberculosis* with the following characteristics: *in vivo* sensitivity against Streptomycin, Rifampicin, Ethambutol and Isoniazid; and with minimum inhibitory concentrations of 2, 4, 0.5 and 0.06 _g/ml LJM, respectively. In the case of punicalagin a patient strain has also been used.

Cultures were incubated for 4 weeks in a vertical position at 36^0C. Cultured tubes were examined visually and sample tubes showing less growth than control tubes were considered to be inhibited (Asres *et al.*,2001).

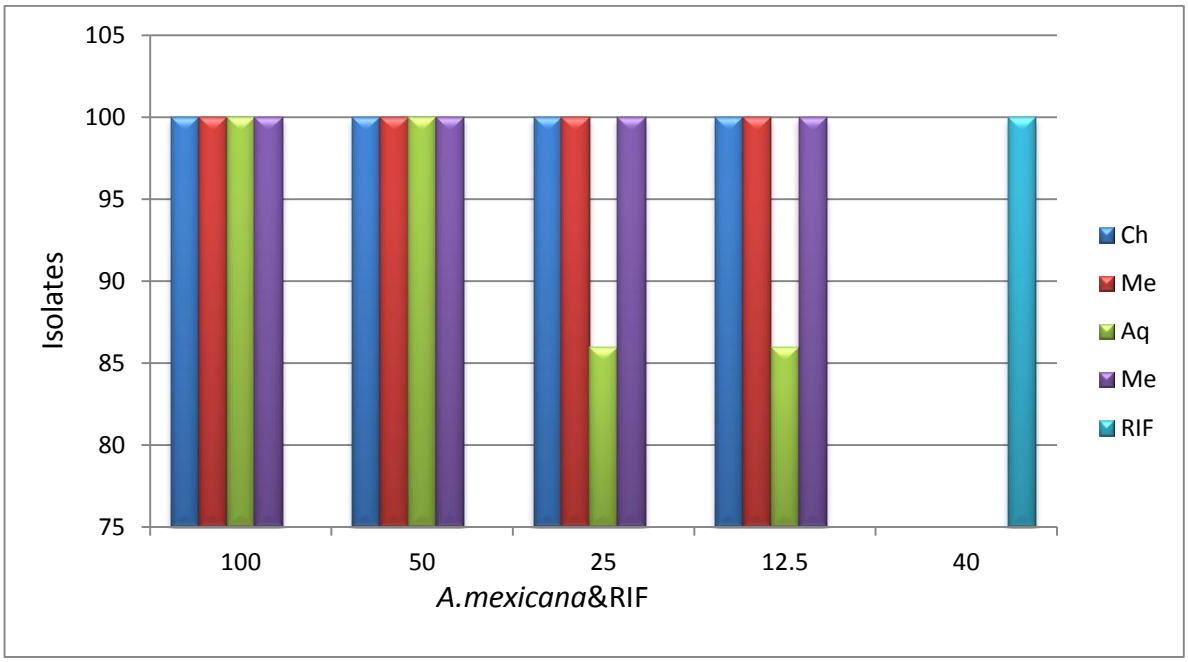
Incubation and Reading:

The slopes was incubated at 37°C.Read the proportion tests was read at 28 days and again at 42 days. Growth was recorded as:3+ confluent growth ,2+ more than 100 colonies, 01-99 cols.The actual number of colonies. When the number of colonies on a given dilution is less than 15, the number of colonies was counted with the next larger inoculum, or estimate if more than 100. (Make no attempt to estimate the number of colonies if the growth is 3+)

Statistical analysis Analysis of variance (ANOVA) will be conducted to test the effect of the different concentrations of the plant extracts (Snedecor and Cochran, 1989).

Table (1).The activity percent of *Argemone mexicana* extracts against isolates

Plant	Part Used	Solvent	Concentractions (mg/ml)				Rifampicin
			100	50	25	12.5	
Argemone mexicana	Leaves	Chloroform	100	100	100	100	100
		Methanol	100	100	100	100	
		Aqueous	100	100	86	86	
	Seeds	Methanol	100	100	100	100	



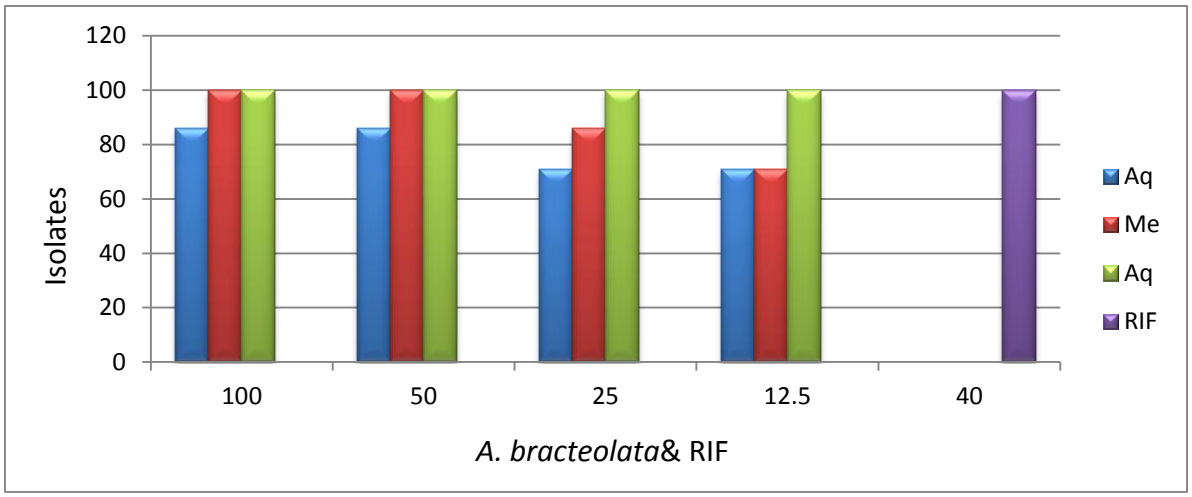
Figure(1):In hibition percent of *Argemone mexicana* and Rifampicin against infection *M.t* isolates

Ch : Chloroform , Me : Methanol , Aq : Aqueous

RIF: Rifampicin , *M.t* : *Mycobacterium tuberculosis*

Table(2).The activity percent of *Aristolochia bracteolata* extracts against isolates.

Plant	Part Used	Solvent	Concentractions (mg/ml)				Rifampicin
			100	50	25	12.5	
Aristolochia bracteolate	Leaves Seeds	Aqueous	86	86	71	71	100
		Methanol	100	100	86	71	
	Seeds	Aqueous	100	100	100	100	



Figure(2):In hibition percent of *Aristolochia bracteolata* and Rifampicin against infection *M.t* isolate

Aq : Aqueous , Me : Methanol

RIF : Rifampicin , *M.t* : *Mycobacterium tuberculosis*

Table (3). Minimum Inhibitory Concentrations (MICs)(mg/ml) of *Argemone mexicana*

Isolates	MIC(mg/ml)			
	Leaves Aqueous	Leaves Chloroform	Leaves Methanol	Seeds Methanol
M.t $_1$	<12.5	<12.5	<12.5	<12.5
M.t $_2$	12.5	<12.5	<12.5	<12.5
M.t $_3$	100	<12.5	<12.5	12.5
M.t $_4$	12.5	<12.5	<12.5	25
M.t $_5$	>100	50	>100	12.5
M.t $_6$	100	50	100	>100
M.t $_7$	25	50	12.5	25

M.t $_{1-7}$ = *Mycobacterium tuberculosis* isolates

Table (4).Minimum Inhibitory Concentrations (MICs)(mg/ml) of *Aristolochia bracteolate.*

Isolates	MIC(mg/ml)		
	Leaves Aqueous	**Seeds Aqueous**	**Seeds Methanol**
M.t $_1$	50	<12.5	<12.5
M.t $_2$	12.5	100	12.5
M.t $_3$	<12.5	25	25
M.t $_4$	<12.5	50	50
M.t $_5$	>100	>100	>100
M.t $_6$	100	>100	>100
M.t $_7$	50	25	25

M.t $_{1-7}$ = *Mycobacterium tuberculosis* isolates

Results and Discussion:

A. mexicana is considered as an important medicinal plant in India; the yellow juice, which exudes when the plant is injured, has long been used in India as traditional medicine for dropsy, jaundice, ophthalmia, scabies and cutaneous affections. Different parts of this plant are used in chronic skin diseases, and also as emetic, expectorant, demulcent and diuretic; the seeds oil are employed as a remedy for dysentery, ulcers, asthma and other intestinal affections. (Vandita , 2009 and Amit , 2011).The results obtained by *Argemona mexicana* indicated that, methanolic, chloroformic and aqueous extracts of the leaves .The methanolic and chloformic extracts of the seeds showed high activity against *M. tuberculosis* better than Rifampicin, while the aqueous extract of the seeds had no activity. The methanolic and chloformic extracts of the leaves showed high activity against *M. tuberculosis* better than Rifampicin, while the aqueous extract of the leaves had moderate activity.The methanolic and chloformic extracts of the leaves showed high MIC (mg/ml)Table (3). *A.bracteolata* leaves were subjected to antibacterial activity on disc diffusion method against bacillus subtilus, lactobacillus plantarum, Escherichia coli, staphylococcus aureus, streptococcus faecalis and pseudomonas aeruginosa. The leaves of *Aristolochia bracteolata* Retz were extracted with petroleum ether, chloroform and alcohol. Alcoholic extract showed significant antibacterial activity as compared to that of other extracts(Thirumal *et al*.,2012). The aqueous extracts of seeds *Aristolochia bracteolate* exhibited high MIC (mg/ml) compare with methanolic extracts of the seeds Table (4).The methanolic, chloroformic and aqueous extracts of the seeds and aqueous extract of the leaves of *Aristolochia bracteolata* exhibited high activity compare with Rifampicin. The aqueous extracts of seeds *Aristolochia bracteolate* exhibited high activity compare with Rifampicin. The results obtained by *Argemona mexicana* indicated that, methanolic, chloroformic and aqueous extracts of the leaves .The methanolic and chloformic extracts of the seeds showed high activity against *M. tuberculosis* better than Rifampicin, while the aqueous extract of the seeds had no activity. The methanolic and chloformic extracts of the leaves showed high activity against *M. tuberculosis* better than Rifampicin, while the aqueous extract of the leaves had moderate activity.

Conclusions:

Isolation identification of active substances from the extracts Which exhibited promising activities need to be carried out.The results of this study have further shown that there is potential to develop new compounds against multi drug resistant TB from Plants.

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Evaluation of Some Clinical Indices of Three Ketamine Protocols Used for Performing Laparotomy in Ddonkeys

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ABSTRACT

The cardiopulmonary effects and the effect on some clinical indices of three different protocols containing Xylazine, or Detomidine or Romifidine as pre-anaesthetic medications and ketamine used for total intravenous anaesthesia (TIVA) were evaluated in 18 donkeys undergoing laparotomy. Donkeys were randomly distributed into three groups each of six individuals. Each group was either treated with Xylazine (2 mg/kg) or Detomidine (50 µg/kg) or Romifidine (100 mcg/kg) intravenously as pre-anaesthetic medication and anaesthetized with an intravenous injection of Ketamine 4 mg/kg and followed by infusion of XKI (Xylazine 2 mg/kg and Ketamine 6 mg/kg) or DKI (Detomidine 50µg/kg and 6 mg/kg Ketamine) or RKI (Romifidine 100 µg/kg and Ketamine 6 mg/kg) mixed with saline drip. Donkeys anaesthetized with the above mentioned protocols were subjected to laparotomy under field conditions. Physiological parameters: respiratory rate, heart rate and rectal temperature were monitored before, during and following induction of anaesthesia. Some blood biochemical parameters: urea, glucose, ALT, and AST were measured before and during anaesthesia. Using of each of the protocols evaluated in this study resulted in minimal effect on the physiological parameters and blood biochemical parameters monitored except for rectal temperature and urea concentration which found to be affected significantly. It could be concluded that each of the three protocols could be used safely in this species although the significant change in urea level may limit repeated usage of these protocol in the same animal.

Key words*: Donkey; Ketamine; TIVA,Clincal indices, urea level*.

المستخلص:

في هذه الدراسة تمت دراسة الآثار القلبية الوعائية وبعض الآثار السريرية الأخرى الناتجة من إستخدام ثلاثة بروتوكولات تخديرية تتكون من الزايلازين والديتوميدين والروميفيدين والتي أستخدمت كعلاجات تمهيدية إضافة إلى مخدر الكيتامين. أجريت الدراسة على عدد 18 حمار من الحمير البلدية. تم تقسيم الحيوانات عشوائياً الى ثلاثة مجموعات كل واحدة تتكون من 6 افراد. كل مجموعة من الحيوانات تم حقنها بواحد من العقارات التالية عن طريق الحقن الوريدي كعلاج تمهيدي : الزايلازين (2 ملجم/كجم) او الديتوميدين (50 ميكروجرام/كجم) او الروميفيدين (100 ميكروجرام /كجم). عقب العلاج التمهيدي كل فرد من افراد المجموعات الثلاثة تم حقنه بعقار الكيتامين بجرعة 4 ملجم/كجم عن طريق الوريد الذي اعقبه التسريب الوريدي للبروتوكولات (زايلازين

2ملجم/كجم+ كيتامين 6ملجم/كجم) او (ديتوميدين 50 ميكروجرام / كجم + كيتامين 6ملجم / كجم) أو بروتوكول (روميفيدين 100 ميكروجرام / كجم + كيتامين 6 ملجم/كجم). تم اجراء عملية فتح البطن في الحمير التي تم تخديرها عاليه وأثناء التخدير تمت دراسة بعض المعالم التي تمثلت في التنفس ومعدلات ضربات القلب ومعدل درجة حرارة الجسم كما تم كذلك دراسة معدلات تركيز جلوكوز الدم وتركيز اليوريا وتركيز انزيم الانين امينو ترانسفيريز واسبارتيت امينوترانسفيريز. استخدام اي من البروتوكولات التي تم اختبارها ادى الى احداث اثار طفيفة على المعالم التي تم قياسها فيما عدا درجة حرارة الجسم ومعدل تركيز اليوريا بالدم والتي اظهرت تغيرات معنوية عند استخدام هذه البروتوكولات. خلصت الدراسة إلى أنه يمكن استخدام هذه البروتوكولات التخديرية في هذا النوع بسلامة الا ان ارتفاع تركيز معدل اليوريا في الدم قد يحد من تكرار استخدام هذه البروتوكولات في نفس الحيوان.

INTRODUCTION:

Many surgical procedures in equines are performed under general anaesthesia in order to enhance their accuracy and maximize personal safety. A variety of methods were used for induction of anaesthesia depending on the available drugs, size and condition of the donkeys and familiarity with different protocols. Different combinations of drugs were used for anaesthesia in donkeys Albozachri *et al*., (2012) recommended thiopentone in combination with diazepam (0.1 mg/kg) as safe protocols to be used in donkeys under field conditions. (Radi *et al.*, 2012), reported the negative effects of thiopentone on respiration. Ketamine in combination with diazepam was reported to induce safe anaesthesia and acceptable quality of induction, muscle relaxation and recovery in donkeys under field conditions (Abakar *et al.*, 2014).Donkeys anaesthetized with Ketamine in combination exerted no significant effect on ALT activity (El-Kammar and Gad, 2014, and Amin *et al.*, 2012a), while AST was significantly decreased following intravenous injection of Ketamine in combination with Detomidine in donkeys (El-Kammar *et al*., 2014) and Amin *et al*., (2012a). Late elevation of AST concentration was noticed by (Albozachri *et al*., 2012).Ketamine was reported to have no significant effect on respiratory rate (Tokics *et al*., 1987), no effect on body temperature (Davison *et al*., 2007, and Abakar *et al*., 2014) but it might have stimulatory effect on the heart (Haskins *et al*., 1985).

The aim of this investigation is to study some physiological and biochemical effects of ketamine combinations used for performance of surgery under field conditions.

Materials and Methods:

Place of the study:

This study was carried out at the College Farm, Faculty of Veterinary Medicine, Al-Butana University, Sudan.

Experimental Animals:

A total of 18 healthy local breed donkeys, 12 males and 6 females were used in this study, they were divided into three equal groups. Their age was between 3-5 years with average body weight of 90±10 kg. The animals were kept in the place of the study in closed pens throughout the duration of the study. They were fed on green fodder, hay and supplemented with concentrates with free access to water. The animals were kept for two weeks to get acclimatized before starting experiments.

Handling:

Protective bedding made of empty sacks and sandy ground was used to protect the animals during induction, maintenance of anaesthesia, surgery and during recovery.

Drugs:

1. Ketamine Hcl 5% (Troika pharmaceuticals Ltd Thol-382728 Gujarat, India).This drug was used as anaesthetic.
2- XylazineHcl 2% (CevaTiergesundheitb GmbH- Kanzlerstr. 4-40472 Dusseldor).
3- Detomidine 1% (Orion pharma.13483-2).
4- Romifidine 1% (BoehringerInglheimVetmedicaGmbhBlinger 173 55216 Inglheim).

Anaethetic protocols:

The following anaesthetic protocols were evaluated in this study:
1- Xylazine 2% (2mg/kg) + Ketamine 5% (4mg/kg) + infusion with saline drip containing Xylazine 2% (2mg/kg) + Ketamine 5% (6 mg/kg).
2- Detomidine 1% (50µg/kg) + Ketamine 5% (4mg/kg) + Infusion with saline drip containing Detomidine 1% (50µg/kg) + Ketamine 5% (6mg/kg).
3- Romifidine 1% (100µg/kg) + Ketamine 5% (4mg/kg) + Infusion with saline drip containing Romifidine 1% (100µg/kg) + Ketamine 5% (6mg/kg).

Physiological indices:

Respiratory rate (cycle/min.): Respiratory rate was recorded using standard methods described by (Kelly, 1984).

Heart rate (beat/min): Heart rate was recorded by counting the heart beats over the cardiac area using a stethoscope through a whole minute of time as described by (Kelly, 1984).

Rectal temperature (°C): Rectal temperature was recorded using a clinical digital thermometer from the rectum. The rectum usually emptied from faeces and the thermometer lubricated before insertion in the rectum (Kelly, 1984).

Blood samples collection and biochemical analysis:

Blood samples collection:

Blood samples were collected in tubes coated with fluoride oxalate as anti-coagulant (AFCO-DISPO, Jordan). The blood in the tubes was immediately and thoroughly mixed with the anticoagulant, placed in ice, sent to the laboratory and immediately centrifuged to separate plasma. The separated plasma in each tube was harvested and kept at -20 ºC until analysed. Blood samples were collected during anaesthesia at base line sample, 30, 60 and 90 minutes after induction of anaesthesia.

Blood biochemical methods:

Glucose:

Glucose was measured using commercial kit (Vitro Scient-Egypt). Enzymatic method was firstly described by Keilin and Hartree (1948) using glucose oxidase and later, this method was modified by (Keston 1956), using glucose oxidase/peroxidise system and o-dianisidinechromogen system.

Urea:

Urea was measured using commercial kit (Vitro Scient-Egypt) according to enzymatic colorimetric method described firstly by Marshall (1913) who added urease enzyme and measured the liberated ammonia with titration with an acid, this method has been used and modified and later modified by Fawcett and Scott (1960).

Aspartate aminotransferase (AST) (Glutamic–Oxaloacetic transaminase (GOT)

AST was analyzed in accordance with kinetic ultraviolet method. Karmen *et al.*, (1955) described the first kinetic method using a couple reaction of MDH and NADH in 1960 this method modified by Henry *et al.* (1960). AST was analyzed using commercial kit (Vitro Scient-Egypt) as described by Barham and Trinder (1972).

Alanine aminotransferase (ALT) (Glutamate Pyruvate transaminase (GPT)

The Vitro ALT Kits is based on the recommendations of the IFCC (IFCC, 1986).

Surgical laparotomy:

Standard method for performing laparotomy was used in this study according to the following steps:

- The skin was incised for approximately 10-15 cm in the right flank region.
- The time elapsed from anaesthesia induction up to skin incision was 4- 6 minutes.
- Time for incision of muscles 6-8 minutes after induction of anaesthesia.
- Time for start suturing of muscles 20-33 minutes after induction of anaesthesia
- Time for finishing suturing of muscles 26-38 minutes after induction of anaesthesia.
- Time of starting suturing of skin 28- 41 minutes after induction of anaesthesia.
- Time for finishing suturing of skin 32- 46 minutes after induction of anaesthesia.

Statistical analysis:

ANOVA was used to compare data for physiological parameters and blood biochemical indices. GraphPad Prism 5.0 (GraphPad Software) was used to perform these analytical operations.

Results:

Using XKIS resulted in a significant decrease ($p \leq 0.05$) in the respiratory rate 10 minutes after injection of Xylazine and 10 minutes after induction of anaesthesia. A significant increase ($p \leq 0.05$) in respiratory rate occurred at 40 minutes after induction of anaesthesia with XKIS. While, induction and maintenance of anaesthesia with DKIS resulted in non significant decrease in respiratory rate 10 minutes after injection Detomidine and lasted for 30 minutes after induction of anaesthesia. Induction and maintenance of anaesthesia with RKIS resulted in a significant decrease ($p \leq 0.05$) in

respiratory rate 10 minutes after injection of Romifidine and immediately after induction of anaesthesia (figure 1).

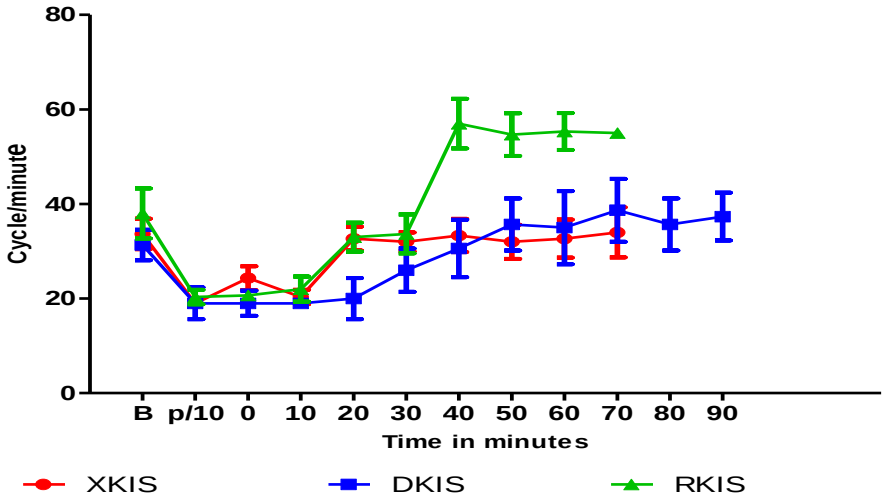


Figure 1: Effect of induction and maintenance of anaesthesia with XKI, DKI and RKI and performing laparotomy in donkeys on respiratory rate

No significant change in the heart rate was observed following induction of anaesthesia and performing laparotomy using XKIS, DKIS and RKIS in donkeys (Figure 2).

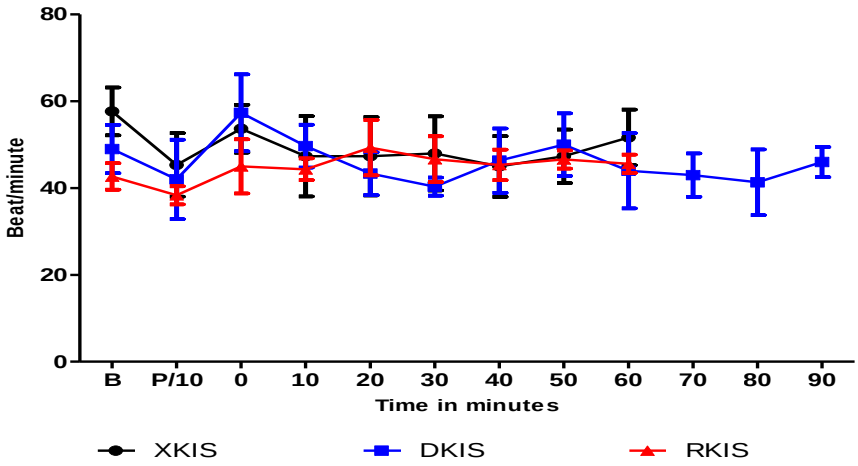


Figure.2: Effect of induction and maintenance of anaesthesia with XKI, DKI and RKI and performing laparotomy in donkeys on heart rate.

Injection of the three pre-anaesthetic drugs resulted in significant ($p \leq 0.05$) decrease in rectal temperature10 minutes following injection of the drugs. While induction and maintenance of anaesthesia with XKIS and DKIS resulted in significant ($p \leq 0.05$) decrease in rectal temperature up to 40 and 50 minutes following induction of anaesthesia, respectively. Using RKIS resulted in significant decrease ($p \leq 0.05$) in rectal temperature, immediately after induction of anaesthesia which lasted for10 minutes after induction of anaesthesia.

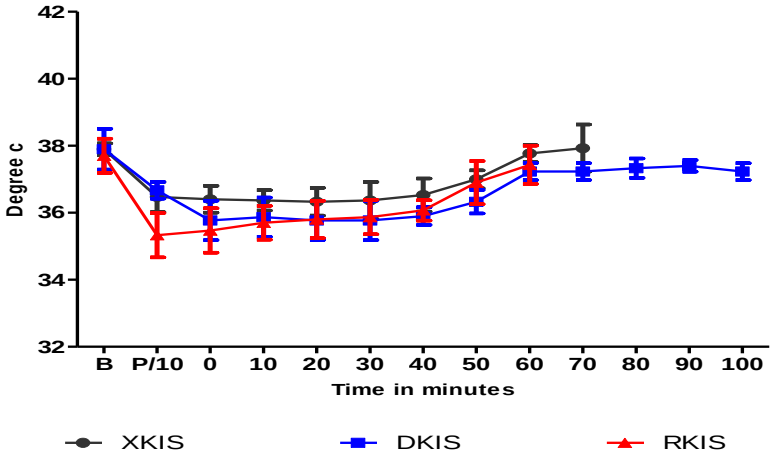


Figure 3: Effect of induction and maintenance of anaesthesia with XKI, DKI and RKI and performing laparotomy in donkeys on rectal temperature

Significant ($p \leq 0.05$) change in urea concentration was detected as a result of using the three protocols. The increase in the level of urea was observed at 30 minutes following induction and it remained until 90 minutes after induction of anaesthesia. Only XKIS induced significant ($p \leq 0.05$) increase in glucose level at 30, 60 and 90 minutes following induction and maintenance of anaesthesia, while DKIS and RKIS resulted in no significant changes of glucose level during the course of anaesthesia and surgery until recovery was attained. No significant change was observed to occur in ALT and AST activity following induction and maintenance of anaesthesia using the above mentioned protocols (Table 1).

Table 1: Effect of induction and maintenance of anaesthesia with XKIS, DKIS and RKIS and performing laparotomy on some blood biochemical constituents in donkeys

Parameters (unit)	Protocols	Time (minutes)			
		Base	30	60	90
Urea (mmol/l)	XKIS	2.70±0.35a	4.97±0. 71b	4.250±0.44b	4.66±0.11b
	DKIS	2.69±0.52a	4.67±0.18b	4.25±0.63b	4.49±0.73b
	RKIS	2.84±0.60a	4.65±0.98b	5.16±0.33b	5.50±0.35b
Glucose (mmol/l)	XKIS	2.32±0.73a	5.32±1.74b	5.73±1.86b	5.41±2.08b
	DKIS	4.09±2.85a	5.00±1.38a	5.02±0.60a	5.16±1.67a
	RKIS	4.05±0.92a	4.86±1.34a	4.80±1.79a	4.85±0.41a
ALT (UI)	XKIS	6.59±0.66a	7.02±1.49a	5.40±1.32a	4.74±0.46a
	DKIS	6.84±1.60a	6.71±1.70a	6.12±1.38a	6.69±1.52a
	RKIS	5.23±1.01a	5.04±0.33a	6.21±2.20a	5.20±1.70a
AST (UI)	XKIS	89.00±38.57a	84.63±37.17a	94.13±41.85a	82.50±22.25a
	DKIS	123.3±49.17a	149.7±9.07a	154.3±25.11a	158.3±30.07a
	RKIS	97.00±19.70a	94.33±25.42a	97.67±32.62a	103.0±13.11a

- Different letters in the same raw indicate significant difference ($p \leq 0.05$).

Discussion:

In this study three anaesthetic protocols were evaluated for their safety and efficacy in performing laparotomy in donkeys with special emphysis on their effect on some physiological and blood parameters. The drop in respiration occurred in this study may be due to the effect of alpha 2 adrenoceptor agonists used since they expected to cause a drop in the respiratory rate as reported by Luna *et al*., (2000). Ketamine was reported to have no significant effect on respiratory rate (Tokics *et al*., 1987, Morse *et al.*, 2004, and Von Ungern-Sternberg *et al.*, 2007). Xylazine, Detomidine and Romifidine were reported to have a brady-cardiogenic effect as reported by (Vainio, 1982, Joseph *et al*., 1982; Booth, 1988, Seo *et al.*, 2011; and Amin *et al*., (2012b). These observations strongly support results obtained in the current study, where the three premedications resulted in a drop in the heart rate 10 minutes after their injection. Using XKIS, DKIS or RKIS for induction and maintenance of anaesthesia in this study resulted in no significant change in heart rate. The stimulatory effect of Ketamine reported by Haskins *et al*., (1985) might have an antagonising effect on the bradycardiogenic effect of the pre-anaesthetic medications, hence the no significant effect of the combinations on heart rate. Ketamine was reported to have no effect on body temperature (Davison *et al*., 2007, and Abakar *et al*., 2014). Body temperature generally decreases as a result of using $\alpha_2$adrenoceptors (England and Clarke, 1996). Xylazine, Detomidine and Romifidine were reported to have a hypothermic effect (Khan *et al*., 2004; Amin *et al.*, 2012b, and El-Kammar and Gad, 2014). So the hypothermia resulted in this study may be due to the effect of the three drugs on body temperature. Also anaesthesia for a long time may affect basal metabolic rate which might cause hypothermia.

The three protocols evaluated in this study were observed to cause significant increase in blood urea. Our finding is supported by the findings of Ali, (2013), Okwudili *et al*., (2014) and El-Kammar *et al.*, (2014), who reported similar results following the use of the same protocols. El-Maghraby *et al.*, (2005) reported that the effect of Romifidine on urea level is dose dependent. Using any of the three protocols in this study resulted in increase in blood glucose. Blood glucose level usually increased in different animal species as a result of using Xylazine alone or in combination with other drugs as reported by Kullmann *et al*., (2014) in horses, Ismail *et al*., (2010) in sheep and goats. Studying the effect of Detomidineon blood glucose level in horses Thurmon *et al*., 1982, and Ambrosio *et al.*, 2012 reported the significant increase in blood glucose as a result of using Detomidine. Romifidine was also reported to cause significant increase in serum glucose level as a result of using it alone (El-Maghraby *et al.*, 2005) or in combination with other drugs as reported by Amin *et al*., (2012). Serum glucose level was reported to be none significantly affected in donkeys as a result of using Ketamine in combination with Detomidine (EL-Kammar and Gad, 2014). On the other hand Amin *et al*., (2012a) reported a significant increase in serum glucose in female donkeys as a result of using some Ketamine combinations for induction of anaesthesia.Effect of different protocols of Ketamine had been studied by different researchers. Xylazine/Ketamine combination in Greyhound (Camekrten *et al.*, 2013), Detomidine/Ketamine (El-Kammar and Gad, 2014) and Romifidine/Ketamine (Amin *et al*., 2012a) and (El-Kammar *et al.*, 2014). All those combinations of Ketamine protocols investigated in literature reflected no significant effect on ALT. These findings

are in line with the results obtained in this study.Induction and maintenance of anaesthesia with each of the three protocols XKIS, DKIS or RKIS resulted in no significant changes on AST level. Our findings in case of XKIS and DKIS are supported by the result ofEl-Kammar and Gad, 2014, Ismail *et al*., (2010) and Camekrten *et al.*, (2013) who reported no significant effects of Xylazine, Detomidine or Ketamine on AST.

Conclusions:

It could be concluded that the three protocols evaluated in this study could be used safely and efficiently in donkey, although the increase in blood urea level may limit the repeated usage of the protocol on the same animal.

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Maximal Norm on Higher Power Weighted Bergman Spaces of Composition

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ABSTRACT:

We show that any composition operator with maximal norm on one of the weighted Bergman spaces $L^2_{(\alpha+1)^2-1}$ (in particular, on the space $L^2 = L^2_0$) is induced by a disk automorphism or a map that fixes the origin. This result demonstrates a major difference between the weighted Bergman spaces and the Hardy space H^2, where every inner function induces a composition operator with maximal norm.

المستخلص:

نوضح أن أي عامل تركيب ذو معيار كبير على إحدى فضاءات بيرجمان $L^2_{(\alpha+1)^2-1}$ (على وجه الخصوص في الفضاء $L^2 = L^2_0$) محدّث بواسطة التشكل الذاتي للقرص أو تطبيق يحدد نقطة الاصل . تبرهن هذه النتيجة اختلافًا كبيرًا بين فضاءات بيرجمان الموزونة وفضاء هاردي H^2 ، حيث تحث كل دالة داخلية عامل تركيب مع معيار أكبر.

Keywords: composition operators, Hardy spaces, weighted Bergman spaces, disk automorphism

1.INTRODUCTION:

Let $\mathbb{D}$ denote the open unit disk in the complex plane, with dL signifying normalized area measure on $\mathbb{D}$. Recall that the Hardy space H^2 is the set of all analytic functions f on $\mathbb{D}$ such that

$$\|f\|^2_{H^2} = \frac{1}{2\pi} \sup_{0<r<1} \frac{1}{2\pi} \int_0^{2\pi} \left|f\left(re^{i\theta}\right)\right|^2 d\theta < \infty \ .$$

For $\alpha > -1$, the weighted Bergman space $L^2_{(\alpha+1)^2-1}$ consists of all analytic f on $\mathbb{D}$ for which

$$\|f\|^2_{(\alpha+1)^2-1} = \int_{\mathbb{D}} |f(z)|^2 \, (\alpha+1)^2 (1-|z|^2)^{(\alpha+1)^2-1} dL(z)$$
$$= \frac{(\alpha+1)^2}{\pi} \int_0^1 r(1-r^2)^{(\alpha+1)^2-1} \left(\int_0^{2\pi} \left|f\left(re^{i\theta}\right)\right|^2 d\theta \right) dr$$

is finite. The space L^2_0, usually denoted L^2, is called the (unweighted) Bergman space. The Hardy space H^2 and the weighted Bergman spaces $L^2_{(\alpha+1)^2-1}$ are all Hilbert spaces, each under the obvious inner product. The properties of these spaces are discussed further in [5], [6], and [9].

Let φ be an analytic self-map of $\mathbb{D}$. If $\mathcal{H}$ is a Hilbert space of analytic functions on $\mathbb{D}$, we define the composition operator C_φ on $\mathcal{H}$ by the rule $C_\varphi(f) = f \circ \varphi$. It is well known that any φ induces a bounded composition operator on H^2, with

$$\frac{1}{1-|\varphi(0)|^2} \leq \left\| C_\varphi : H^2 \to H^2 \right\|^2 \leq \frac{1+|\varphi(0)|}{1-|\varphi(0)|} \qquad (1)$$

see [Corollary 1.1]. Likewise, every composition operator is bounded on each of the weighted Bergman spaces $L^2_{(\alpha+1)^2-1}$, with

$$\left(\frac{1}{1-|\varphi(0)|^2}\right)^{(\alpha+1)^2+1} \leq \left\| C_\varphi : L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1} \right\|^2 \leq \left(\frac{1+|\varphi(0)|}{1-|\varphi(0)|}\right)^{(\alpha+1)^2+1} \qquad (2)$$

(The proof of (2) is similar to that of (1); see, for example, [Lemma 1.2].) When $\varphi(0) = 0$, it is easy to see that the norm of the corresponding composition operator, acting on either the Hardy space or one of weighted Bergman spaces, is equal to 1. When $\varphi(0) \neq 0$, on the other hand, it is quite difficult to determine the norm of C_φ exactly. (See [1], [2], [7], [8], [10], and [13] for explicit norm calculations.

One problem that has attracted significant attention is the question of which composition operators have maximal norm on a particular Hilbert space. In other words, for the Hardy space H^2, one would like to identify the maps $\varphi: \mathbb{D} \to \mathbb{D}$ for which

$$\left\|C_\varphi : H^2 \to H^2\right\|^2 = \frac{1+|\varphi(0)|}{1-|\varphi(0)|} \qquad (3)$$

Similarly, for a weighted Bergman space $L^2_{(\alpha+1)^2-1}$, one would like to determine when

$$\left\|C_\varphi : L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}\right\|^2 = \left(\frac{1+|\varphi(0)|}{1-|\varphi(0)|}\right)^{(\alpha+1)^2+1}. \qquad (4)$$

This question has already been answered in the context of the Hardy space. In one of the earliest papers on composition operators, Nordgren [13] showed that $C_\varphi : H^2 \to H^2$ has maximal norm whenever φ is an inner function; that is, whenever $lim_{r\uparrow 1}\left|\varphi\left(re^{i\theta}\right)\right| = 1$ for almost all θ in $[0, 2\pi)$. More recently, Joel Shapiro [19] demonstrated that, when $\varphi(0) \neq 0$, these are the only composition operators with maximal norm on H^2. Until now, this problem has remained open in the setting of the weighted Bergman spaces, even for the space $L^2 = L^2_0$.

We remark that the complementary question—which composition operators have minimal norm—can be answered without much difficulty. In fact, when $\varphi(0) \neq 0$, the only composition operators with minimal norm, either on the Hardy space or one of the weighted Bergman spaces, are those with constant symbol (see, [Theorem 1.3], and [Theorem 1.4]).

Corollary 1.1: If φ is an analytic map of the disk into itself, then on the Hardy space $H^p(D)$, $p \geq 1$,

$$\frac{1}{1-|\varphi(0)|^2} \leq \|C_\varphi\| \leq \left(\frac{1+|\varphi(0)|}{1-|\varphi(0)|}\right)^{1/p}$$

Lemma 1.2. If $\varphi: \mathbb{D} \to \mathbb{D}$ is analytic, then on the weighted Bergman space $L^2_{(\alpha+1)^2-1}$,

$$\left(\frac{1}{1-|\varphi(0)|^2}\right)^{((\alpha+1)^2+1)/2} \leq \|C_\varphi\| \leq \left(\frac{1+|\varphi(0)|}{1-|\varphi(0)|}\right)^{((\alpha+1)^2+1)/2}$$

proof. Let $\psi(z) = (\varphi(0) - z)/\left(1 - \overline{\varphi(0)}z\right)$ and let $\varphi_0 = \psi \circ \varphi$. Let f be a polynomial. We then have that

$$\left\|C_\psi f\right\|^2 = \int_{\mathbb{D}} \left|f\left(\psi(z)\right)\right|^2 (1-|z|^2)^{(\alpha+1)^2-1} \frac{dA(z)}{\pi}$$

$$= \int_{\mathbb{D}} |f(w)|^2 (1-|\psi^{-1}(w)|^2)^{(\alpha+1)^2-1} |\psi'(w)|^2 \frac{dA(w)}{\pi}$$

We can now find an upper bound for this equation, to get

$$\left\|C_\psi f\right\|^2 \leq \int_{\mathbb{D}} |f(w)|^2 (1-|w|^2) \left(\frac{1+|\psi(0)|}{1-|\psi(0)|}\right)^{(\alpha+1)^2-1} \left(\frac{1+|\psi(0)|}{1-|\psi(0)|}\right)^2 \frac{dA(w)}{\pi}$$

Therefore, $\left\|C_\psi\right\| \leq \left(\frac{1+|\psi(0)|}{1-|\psi(0)|}\right)^{((\alpha+1)^2+1)/2}$.

To show that this bound is sharp, we look at the adjoint acting on the kernel functions $K_w^{(\alpha+1)^2-1}$ as w goes to the boundary.

$$\|C_\psi\| = \|C_\psi^*\| \geq \frac{\left\|K_{\psi(w)}^{(\alpha+1)^2-1}\right\|}{\left\|K_w^{(\alpha+1)^2-1}\right\|} = \left(\frac{1+|w|^2}{1-|\psi(w)|^2}\right)^{((\alpha+1)^2+1)/2}$$

If we write $\psi(0) = se^{i\theta}$ and let $w = re^{i\theta}$ we get that

$$\|C_\psi\| \geq lim_{r\to 1}\left(\frac{1+|w|^2}{1-|\psi(w)|^2}\right)^{((\alpha+1)^2+1)/2} = \left(\frac{1+|\psi(0)|}{1-|\psi(0)|}\right)^{((\alpha+1)^2+1)/2}$$

We note that $\psi = \psi^{-1}$ and $\varphi(0) = \psi(0)$ so

$$\|C_\varphi\| \leq \|C_{\varphi_0}\|\|C_\psi^{-1}\| = \left(\frac{1+|\varphi(0)|}{1-|\varphi(0)|}\right)^{((\alpha+1)^2+1)/2}$$

Additionally,

$$\|C_\varphi\| = \|C_\varphi^*\| \geq \frac{\left\|C_\varphi^* K_0^{(\alpha+1)^2-1}\right\|}{\left\|K_0^{(\alpha+1)^2-1}\right\|} = \frac{\left\|K_{\varphi(0)}^{(\alpha+1)^2-1}\right\|}{\left\|K_0^{(\alpha+1)^2-1}\right\|} = \left(\frac{1}{1-|\varphi(0)|^2}\right)^{((\alpha+1)^2+1)/2}.$$

Theorem 1.3. Suppose that φ is an analytic self-map of D, $\varphi(0) \neq 0$, and φ is not constant. Then

$$\|C_\varphi\| > \sqrt{\frac{1}{1-|\varphi(0)|^2}}$$

Theorem 1.4. A composition operator C_φ acting on A^p has norm equal to $(1\ |\varphi(0)|^2)^{-2/p}$ if and only if either $\varphi \equiv$ const or $\varphi(0) = 0$.

2. ESSENTIAL NORMS

Let $\mathcal{H}$ be a Hilbert space. Recall that the essential norm $\|T\|_e$ of an operator $T : \mathcal{H} \to \mathcal{H}$ is defined as follows:

$$\|T\|_e = \inf_K \|T - K\|,$$

the infimum being taken over the set of all compact operators $K : \mathcal{H} \to \mathcal{H}$. In other words, the essential norm represents the distance between T and the set of compact operators. It is often helpful to consider the relationship between the norm of an operator and its essential norm. Since the trivial operator is compact, we see that $\|T\|_e \leq \|T\|$ for any $T : \mathcal{H} \to \mathcal{H}$. Furthermore, if $\|T\|_e < \|T\|$, we know that the operator T is norm-attaining (see Proposition 2.2]); that is, there is some unit vector h in $\mathcal{H}$ such that $\|T(h)\| = \|T\|$. We will make use of this fact in the proof of Proposition 3.1.

Now consider a composition operator C_φ, acting on either H^2 or $L^2_{(\alpha+1)^2-1}$. It makes sense to say that C_φ has maximal essential norm whenever line (3) or line (4), as appropriate, holds with the norm of C_φ replaced by the essential norm. The investigation of composition operators with maximal norm will also allow us to characterize the composition operators that have maximal essential norm on $L^2_{(\alpha+1)^2-1}$. We note that this condition is not equivalent to saying that $\|C_\varphi\|_e = \|C_\varphi\|$, a property often called extremal noncompactness. When $\varphi(z) = (1/2)z + 1/2$, for example, one can show that $C_\varphi : L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}$ is extremally noncompact, but that it does not have maximal essential norm.

As it happens, more information is known about the essential norm of a composition operator than about the norm itself. In particular, we have explicit formula for the essential norm of C_φ acting on a variety of spaces. The prototypical result, a formula for the essential norm of a composition

operator on the Hardy space, was established by Joel Shapiro [18]. His technique was later adapted to the weighted Bergman spaces by Poggi-Corradini [14], who obtained a formula for $\left\|C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}\right\|_e$ when $\alpha = 0$ or $\alpha = 1$. Poggi-Corradini's proof relies on the use of contractive zero-divisors for the spaces L^2 and L^2_1. Results due to Shimorin [20, 21], pertaining to contractive divisors, show that Poggi-Corradini's formula is actually valid whenever $0 < (\alpha+1)^2 \leq 2$.

In the course of proving his essential norm formula, Poggi-Corradini demonstrated the following result, which holds for all $\alpha > -1$:

$$\left\|C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}\right\|_e^2 \leq \limsup_{|\alpha|\to 1} \frac{\sum_{z_j\in\varphi^{-1}(a)} W(|z_j|)}{W(|a|)},$$

Where

$$W(r) = \frac{\left(1-r^2\right)^{(\alpha+1)^2+1}}{(\alpha+1)^2+1}.$$

and

$$\limsup_{|\alpha|\to 1} \frac{\sum_{z_j\in\varphi^{-1}(a)} H(|z_j|)}{H(|a|)} \leq \frac{1+|\varphi(0)|}{1-|\varphi(0)|}\left(\frac{1}{\beta(\varphi)}\right)^{(\alpha+1)^2},$$

where $H(r) = |log(r^2)|^{(\alpha+1)^2+1}$ and $\beta(\varphi) = \liminf_{|z|\to 1} (1-|\varphi(z)|)/(1-|z|)$. It is not difficult to see that

$$\limsup_{|a|\to 1} \frac{\sum_{z_j\in\varphi^{-1}(a)} W(|z_j|)}{W(|a|)} = \limsup_{|a|\to 1} \frac{\sum_{z_j\in\varphi^{-1}(a)} H(|z_j|)}{H(|a|)}.$$

Consequently

$$\left\|C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}\right\|_e^2 \leq \frac{1+|\varphi(0)|}{1-|\varphi(0)|}\left(\frac{1}{\beta(\varphi)}\right)^{(\alpha+1)^2}$$

for any analytic $\varphi: \mathbb{D} \to \mathbb{D}$. Suppose then that $\varphi(0) = 0$; and $\beta(\varphi) > 1$ whenever φ is not a rotation. In other words, we have established the following propositions.

Proposition 2.1. Suppose T is a bounded linear operator on a Hilbert space $\mathcal{H}$. Let $\{K_n\}$ be a sequence of compact self-adjoint operators on $\mathcal{H}$, and write $R_n = I - K_n$. Suppose $\|R_n\| = I$ for each , and $\|R_n x\| \to 0$ for each $x \in \mathcal{H}$ then $\|T\|_e = lim_n \|TR_n\|$.

Proposition 2.2. Let φ be an analytic self-map of $\mathbb{D}$ with $\varphi(0) = 0$. If φ is not a rotation, then $\left\|C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}\right\|_e < 1$.

This observation will allow us to obtain the major results of Section 3.

We conclude this section by mentioning a class of subspaces that have proved particularly useful to the study of essential norms. For any natural number m, let $z^m L^2_{(\alpha+1)^2-1}$ denote the subspace consisting of all functions in $L^2_{(\alpha+1)^2-1}$ with a zero of order at least m at the origin (with $zL^2_{(\alpha+1)^2-1} = z^1 L^2_{(\alpha+1)^2-1}$). When $\varphi(0) = 0$, each of these subspaces is invariant under the operator C_φ. In this situation, we write $\left\|C_\varphi\right\|_{(m)}$ to denote the norm of $C_\varphi: z^m L^2_{(\alpha+1)^2-1} \to z^m L^2_{(\alpha+1)^2-1}$. It is well known that the values $\left\|C_\varphi\right\|_{(m)}$ form a nonincreasing sequence, with $\left\|C_\varphi\right\|_e = lim_{m\to\infty} \left\|C_\varphi\right\|_{(m)}$ (see [Proposition 2.1]). One consequence of this fact is that the essential norm of $C_\varphi: z^m L^2_{(\alpha+1)^2-1} \to z^m L^2_{(\alpha+1)^2-1}$, for

any m, is equal to the essential norm of $C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}$. As we shall see, much of the investigation will take place in the setting where $\varphi(0) = 0$.

3. THE MAIN THEOREM

We begin with the following theorem:

Theorem 3.1. Suppose φ is a holomorphic self-map of U with $\varphi(0) = 0$. Then φ is inner if and only if the restriction of C_φ to H^2_0 has norm equal to 1

Proposition 3.2. Let φ, be an analytic self-map of $\mathbb{D}$ with $\varphi(0) = 0$. If φ is not a rotation, then $\|C_\varphi\|_{(1)} < 1$.

Proof. Suppose that φ is not a rotation. Proposition 2.1 dictates that $\|C_\varphi\|_e < 1$. If $\|C_\varphi\|_{(1)} = \|C_\varphi\|_e$, then our claim follows automatically. Suppose then that $\|C_\varphi\|_{(1)} > \|C_\varphi\|_e$. In this case, the operator $C_\varphi: zL^2_{(\alpha+1)^2-1} \to zL^2_{(\alpha+1)^2-1}$. is norm-attaining; that is, there is a unit vector f in $zL^2_{(\alpha+1)^2-1}$ with $\|C_\varphi\|_{(1)} = \|C_\varphi(f)\|_{(\alpha+1)^2-1}$. Examining the proof of the Littlewood Subordination Theorem (see [4, p. 30]), we observe that

$$\int_0^{2\pi} \left|f\left(\varphi\left(re^{i\theta}\right)\right)\right|^2 d\theta < \int_0^{2\pi} \left|f\left(re^{i\theta}\right)\right|^2 d\theta$$

for any $0 < r < 1$, unless either f is constant or φ is a rotation. We have assumed that φ is not a rotation; since f belongs to $zL^2_{(\alpha+1)^2-1}$, it cannot be constant. Therefore $\|C_\varphi\|_{(1)} = \|C_\varphi(f)\|_{(\alpha+1)^2-1} < \|f\|_{(\alpha+1)^2-1}$, as we had hoped to show.

One consequence of this argument is that $C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}$ is an isometry if and only if φ is a rotation; this fact differs somewhat from the analogous results that are known for other Hilbert spaces. For example, C_φ acts isometrically on H^2 if and only if φ is an inner function that fixes the origin. There is yet a different characterization for the isometric composition operators on the Dirichlet space.

For any point w in $\mathbb{D}$, consider the map

$$\psi_w(z) = \frac{w-z}{1-\bar{w}z},$$

the involutive automorphism that interchanges the points 0 and w. If φ is a selfmap of $\mathbb{D}$, we define the Frostman transform φ_w to be the composition $\psi_w \circ \varphi$. If $w = \varphi(0)$, then the map φ_w fixes the origin.

Lemma 3.3. If f is a unit vector in $L^p_{(\alpha+1)^2-1}$, then

$$|f(z)| \le \frac{1}{(1-|z|^2)^{(\alpha+1)^2+1/p}} \quad z \in \mathbb{D}$$

Proposition 3.4. Let φ be an analytic self-map of $\mathbb{D}$ with $\varphi(0) = w$. Then

$$\left\|C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}\right\| \le \left(v + \frac{1-v}{(1+|w|)^{2(\alpha+1)^2+2}}\right)\left(\frac{1+|w|}{1-|w|}\right)^{(\alpha+1)^2+1},$$

where $v = \|C_\varphi\|^2_{(1)}$.

Proof. For the sake of completeness, we reproduce Shapiro's argument. Let f be a unit vector in $L^2_{(\alpha+1)^2-1}$. Since $\varphi = \psi_w \circ \varphi_w$, we see that

$$C_\varphi(f) = C_{\varphi_w}(f \circ \psi_w) = C_{\varphi_w}(g) + f(w),$$

where $g = f \circ \psi_w - f(w)$. Note that $C_{\varphi_w}(g)$ vanishes at the origin, and hence is orthogonal to the constant $f(w)$; therefore

$$\|C_\varphi(f)\|^2_{(\alpha+1)^2-1} = \|C_{\varphi_w}(g)\|^2_{(\alpha+1)^2-1} + |f(w)|^2 .$$

Since g belongs to $zL^2_{(\alpha+1)^2-1}$, we see that

$$\|C_{\varphi_w}(g)\|^2_{(\alpha+1)^2-1} \le \|C_{\varphi_w}\|^2_{(1)} \|g\|^2_{(\alpha+1)^2-1} = v\|g\|^2_{(\alpha+1)^2-1} .$$

Furthermore,

$$\|g\|^2_{(\alpha+1)^2-1} = \|f \circ \psi_w - f(w)\|^2_{(\alpha+1)^2-1} = \|f \circ \psi_w\|^2_{(\alpha+1)^2-1} - 2Re\overline{f(w)}\langle f \circ \psi_w, 1\rangle + |f(w)|^2$$
$$= \|f \circ \psi_w\|^2_{(\alpha+1)^2-1} - 2Re\overline{f(w)}f(w) + |f(w)|^2 = \|C_{\psi_w}(f)\|^2_{(\alpha+1)^2-1} - |f(w)|^2.$$

Since ψ_w is an automorphism of $\mathbb{D}$, we know that

$$\|C_{\psi_w}\|^2 = \left(\frac{1+|w|}{1-|w|}\right)^{(\alpha+1)^2+1}.$$

A well-known estimate (see [Lemma 3.3]) dictates that $|f(w)|^2 \le 1/(1-|w|^2)^{(\alpha+1)^2+1}$. Consequently

$$\|C_\varphi(f)\|^2_{(\alpha+1)^2-1} \le v\|g\|^2_{(\alpha+1)^2-1} + |f(w)|^2 = v\left(\|C_{\psi_w}(f)\|^2_{(\alpha+1)^2-1} - |f(w)|^2\right) + |f(w)|^2,$$
$$= v\|C_{\psi_w}(f)\|^2_{(\alpha+1)^2-1} + |1-v||f(w)|^2$$
$$\le v\left(\frac{1+|w|}{1-|w|}\right)^{(\alpha+1)^2+1} + \frac{1-v}{(1-|w|^2)^{(\alpha+1)^2+1}}$$
$$= \left(v + \frac{1-v}{(1-|w|)^{2(\alpha+1)^2+2}}\right)\left(\frac{1+|w|}{1-|w|}\right)^{(\alpha+1)^2+1},$$

as we had hoped to show.

In particular, if $w = \varphi(0) \neq 0$ and $\|C_{\varphi_w}\|_{(1)} < 1$, we see that $\|C_\varphi\|$ is not maximal. In other words, we have established the main result.

Theorem 3.5. Consider the weighted Bergman space $L^2_{(\alpha+1)^2-1}$, with $\alpha > -1$. Let φ be an analytic self-map of $\mathbb{D}$. If $\varphi(0) \neq 0$, the following conditions are equivalent:

(1) The operator $C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}$ has maximal norm.

(2) The operator $C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}$ has maximal essential norm.

(3) The map $\varphi: \mathbb{D} \to \mathbb{D}$ is an automorphism.

Proof. (3) ⇒ (2) Suppose that φ is an automorphism; it follows that

$$\|C_\varphi\|^2_e \ge \limsup_{|a|\to 1}\left(\frac{1-|a|^2}{1-|\varphi(a)|^2}\right)^{(\alpha+1)^2+1} = \left(\frac{1+|\varphi(0)|}{1-|\varphi(0)|}\right)^{(\alpha+1)^2+1}.$$

In other words, the operator C_φ has maximal essential norm.

(2) ⇒ (1) Since $\|C_\varphi\|_e \le \|C_\varphi\|$, any composition operator with maximal essential norm also has maximal norm.

(1) ⇒ (3) Let $w = \varphi(0)$. If φ is not an automorphism, then the map $\varphi_w = \psi_w \circ \varphi$ is not a rotation. Thus Proposition 3.2 shows that $\|C_{\varphi_w}\|_{(1)} < 1$, so it follows from [Proposition 3.4] that $C_\varphi: L^2_{(\alpha+1)^2-1} \to L^2_{(\alpha+1)^2-1}$ does not have maximal norm.

4. NORMS ON DIFFERENT SPACES

Theorem 4.1. Suppose $\varphi: \mathbb{D} \to \mathbb{D}$ is analytic in a neighborhood of its Denjoy-Wolff point, d. Then $|d| = 1$ and C_φ^* is subnormal on L^2 if and only if

$$\varphi(z) = \frac{(r+s)z + (1-s)d}{r(1-s)\bar{d}z + (1+sr)}.$$

Theorem 4.2. Suppose that

$$\phi_{r,s}(z) = \frac{(r+s)z + 1 - s}{r(1-s)z + 1 + sr}$$

where $0 < s < 1$ and $-1 < r < 0$. Then $\|C_{\phi_{r,s}}\| > \|C_{\phi_{r,s}}\|_e = rad(C_{\phi_{r,s}})$, so that $C^*_{\phi_{r,s}}$ is not hyponormal.

Theorem 4.3. Let $\|C_\varphi\|_e$ denote the essential norm of C_φ, regarded as an operator on H^2. Then

$$\|C_\varphi\|_e^2 = \lim sup\, N_\varphi(w)/(-log|w|) \qquad |w| \to 1$$

In particular, C_φ is compact on H^2. if and only if

$$\lim N_\varphi(w)/(-log|w|) = 0 \qquad |w| \to 1$$

It is an interesting exercise to compare the norm of a composition operator acting on the unweighted Bergman space L^2 to its norm on the Hardy space H^2.

Considering lines (1) and (2), one might be tempted to speculate that

$$\|C_\varphi: L^2 \to L^2\| = \|C_\varphi: H^2 \to H^2\|^2. \qquad (5)$$

In fact, this equality does hold in most of the cases where we know how to calculate both quantities explicitly. Nonetheless, it is possible to find examples of $\varphi: \mathbb{D} \to \mathbb{D}$ for which equation (5) is false. In particular, let

$$\varphi(z) = \frac{(r+s)z + (1-s)}{r(1-s)z + (1+sr)}$$

for $0 < s < 1$ and $-1/7 \leq r < 0$. In this case, Richman [Theorem 4.1] demonstrated that the operator $C_\varphi: L^2 \to L^2$ has subnormal adjoint; hence its norm is equal to its spectral radius, which is $1/\acute{\varphi}(1) = 1/s$. On the other hand, Bourdon et al. [Theorem 4.2] showed that the norm of $C_\varphi: H^2 \to H^2$ is strictly greater than $\sqrt{1/s}$. Likewise, let φ be a nonunivalent inner function with $\varphi(0) \neq 0$. Then, as we have already stated, the corresponding composition operator has maximal norm on H^2. [Theorem 3.5], which we have just proved, shows that C_φ does not have the same property on L^2.

Both examples from the preceding paragraph demonstrate that it is possible for $\|C_\varphi: L^2 \to L^2\|$ to be strictly less than $\|C_\varphi: H^2 \to H^2\|^2$. In light of this observation, it would be interesting to determine whether the inequality

$$\|C_\varphi: L^2 \to L^2\| \leq \|C_\varphi: H^2 \to H^2\|^2.$$

holds for every analytic $\varphi: \mathbb{D} \to \mathbb{D}$. This is an open question that we commend to the reader's attention. We remark that the analogous inequality does indeed hold for essential norms, a fact that can be deduced simply by comparing the relevant formulas, see [Theorem 4.3]).

Conclusion:

(1) We showed that, when the analytic map $\varphi(0) \neq 0$, there are no other composition operators that have maximal norm on the weighted Bergman space $L^2_{(\alpha+1)^2-1}$ [see Theorem 3.5].

(2) We showed that any disk automorphism induces a composition operator with maximal norm on $L^2_{(\alpha+1)^2-1}$ (see, [Lemma 1.2]).

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