Toxicityof *Cordia africana* L. (Gumbail Tree) Extracts on *Anopheles*Larvae
(Diptera: Culicidae)

[1]Elagbash Ibrahim[*2]M. hanai,[3]Sabah Birama,

[1]Department of Biology, Faculty of Education, U of Blue Nile-Sudan
[2]Department of Zoology, Faculty of Science, U of Dalanj-Sudan
[3]Department of Biology, Faculty of Education, U of west kordufan-Sudan

*Corresponding Author: Misaab Hanai, E.mail:mhanai@yahoo.com.
https://orcid.org/ 0000-0003-0533-0781

Abstract:

Mosquitoes transmit diseases to more than 700 million persons annually in Africa, South America, Central America, Mexico and Asia with millions of resulting deaths. Natural products were used to control different diseases. The present study was aiming to investigate the biocidal effect of the aqueous extract of Gumbail tree bark, leaves and fruits on the larvae of *Anopheles*mosquitoes. The plant materials were collected from Zalengi and Kass.While mosquito larvae were collected from Alkariba area, Wad Medani Great locality, Gezira State. A series of Gumbailtree extracts concentrations were prepared and applied against the tested organisms. Percentages of mortality were recorded after 24 hours and each test was replicated three times. The probit analysis was carried out to determine the proper concentrations for producing deaths. AllGumbail tree extracts caused severe death on the tested larvae with varied degrees. The fruits were the highly effective parts the aqueous extract gave (45.65 mg/l and 463.06 mg/l were the values of LC50 and LC95 respectively, for *Anopheles* larvae while the bark was the lower effective partsthe aqueous extracts gave (96.76 mg/l and 1435.96 mg/l were the values of LC50 and LC95 respectively, for *Anopheles* larvae. There are some degrees of malformation observed among the larvae. The recommendation of this study is to continue investigation on natural products to determine and add any products

potential as mosquito larvaicides and the study recommends more scientific research on the same topic particularly the active ingredients of Gumbail tree.

Keywords: Toxicity, Gumbail Tree, *Anopheles,*aqueous extract

المستلخص:

ينقل البعوض الأمراض لأكثر من 700 مليون من البشر سنوياً في أفريقيا وجنوب أمريكا ووسط أمريكا والمكسيك وآسيا مما ينتج عنه ملايين الوفيات. تستخدم المنتجات الطبيعية في مكافحة العديد من الأمراض. هدفت هذه الدراسة لإختبار تأثير المستخلص المائي للحاء وأوراق وثمار شجرة قمبيل على يرقات بعوض الأنوفلس تم جمع العينات النباتية من زالنجي وكاس، بينما تم جمع اليرقات من منطقة الكريبة، محلية ود مدني الكبرى، ولاية الجزيرة. سلسلة من تراكيز مستخلصات شجرة القمبيل تم تحضيرها وتطبيقها ضد الكائنات المختبرة. أخذت قراءات النسب المئوية للوفيات بعد 24 ساعة وتم تكرار كل تجربة ثلاث مرات. تم إستخدام تحليل بروبيت لتحديد التراكيز القاتلة. كل مستخلصات شجرة القمبيل كان لها أثر مميت على يرقات البعوض بدرجات مختلفة. كانت الثمار أكثر الأجزاء تأثيراً حيث أعطى المستخلص المائي (45,65 ملجم/لتر و463,06 ملجم/لتر قيم التراكيز القاتلة ل 50% و95% على التوالي ليرقات الانوفلس. بينما كان اللحاء أقل الأجزاء تأثيراً حيث أعطى المستخلص المائي (96,76 ملجم/لتر و 1435,96 ملجم/لتر قيم التراكيز القاتلة ل 50% و95% على التوالي ليرقات الانوفلس . هناك درجات من التشوهات تم ملاحظتها على اليرقات. توصي هذه الدراسة بمواصلة البحوث على المنتجات الطبيعية لتحديد وإضافة أي منتجات لها المقدرة على قتل يرقات البعوض، كما توصي الدراسة بإجراء مزيد من البحث العلمي في ذات الموضوع ولاسيما المركبات الفعالة في شجرة القمبيل.

الكلمات المفتاحية: السمية، شجرة القمبيل، الأنوفلس، المستخلص المائي.

INTRODUCTION

Mosquitoes serve as vector for various tropical and subtropical diseases which cause destructive effects to human (Kovendan and Murugan, 2011). They do not only transmit parasites and pathogens but they are also a source of allergic reactions that include local skin and systemic sensitivity (Cheng *et al*., 2003). The most common diseases

associated with mosquitoes are dengue fever, chikungunya and yellow fever (Kovendan and Murugan, 2011). Malaria kills just under one million person, each year, mainly children in the Sub-Saharan Africa, with 200-450 million infections annually worldwide (WHO, 2010). Mosquito control has become increasingly difficult because of the indiscriminate use of synthetic chemical insecticides, which have adverse impacts on the environment and disturb ecological balance as some are non-biodegradable (Lipscomb *et al*., 1992).

Insecticides and fungicides should reduce insect and disease problems; be target-specific (kill the pest, but not other organisms); break down quickly; have low mammalian toxicity; and have minimal impact on the environment. Although synthetic products (e.g., pyrethroids and neonicotinoids) have long been an important part of pest management, there are risks in using them. As a result of this, as well as the increased interest in organic gardening, many people are seeking less hazardous alternatives to conventional pesticides. Lists of products that are acceptable in organic plant production can be found at the Organic Materials Review Institute (Moreau *et al*., 2006). Insecticides were used in the Gezira State for many years for controlling mosquitoes and other agricultural pests. The use of insecticides resulted in many ecological and environmental problems (Abdel Karim *et al*., 1985).

Plants may provide an alternative source of compounds for the control of mosquitoes because they are rich in bioactive chemicals, which are active against a limited number of species including specific target insects, and are degradable (Elumalai *et al*., 2010). Many plant extracts are known to be toxic to different species of mosquitoes and could be used to control the diseases they transmit (Willcox and Ellis, 2006).

Gumbail tree (*Cordia africana*) is awide spread tree in tropical Africa. It was spreading from Guinea east to Eritrea, Ethiopia and Kenya, and south to Angola, Zimbabwe, Mozambique and northern South Africa. It is also found in Saudia Arabia and Yemen, and has been planted in many tropical countries. In Sudan the tree is confined to the areas of Ad – Damazin, Darfor and Kordofan (Drummond, 1981). The present study was aiming to investigate the biocidal effect of the aqueous extract of Gumbail tree bark, leaves and fruits on the larvae of *Anopheles* mosquitoes larvae (Diptera: Culicidae).

MATERIALS AND METHODS

Collection and maintenance of larvae:

Mosquito's larvae, pupae and other aquatic organisms were collected during dipping and were put in large plastic container. Then larvae of each species (*Anopheles* and *Culex*) were separated and transferred to the beakers of the toxicity tests by means of a plastic dropper.

Preparation of extracts:

The Gumbail bark, leaves and fruits were collected from Darfur, the collected samples were then let too dry in the shade under the room temperature away from the direct sun light, each dried sample was grounded to fine powder by using an electrical blender. Five gram of each powder was soaked into 15 ml of distilled water and 15 ml of ethanol 95% in conical flasks for 24 hours and then filtered by using a filter paper. The dry weight of the non-dissolved powder (filtrate) of each plant product into each solvent were measured as same as the volume of each resulted extract, so as to calculate the original concentrations (stock concentrations) in terms of w/v (mg/ml).

Test Procedure:

In series (normally, 7 concentrations x 3 replicates for each extract) of plastic cup (each of 250 ml volume), each of which was filled with a total volume of 250 ml tap water, provided with 20 *Anopheles* larvae (of the late third or early fourth instars), and applied with volumes of 0.1, 0.3, 0.5, 1.00, 1.50, 2.00 and 2.50 ml from the stock concentration of each extract, in addition to three cups as control, the toxicity tests were run, following the instructions of WHO (1981). The submission periods were 24 hours. The signs of death to record the mortality data follow Busvine (1971). The tests were repeated in three different times.

Statistical analysis:

The concentrations used were transformed to the corresponding logarithms, whereas, the mean (of three replicates) corrected mortalities were transformed to probit (Finney, 1936). Simple regression analysis was run for log's (X variable) and probits (Y variable) so as to obtain the intercept (a) and the regression coefficient (b), in addition to R^2; the homogeneity factor. By using the regression equation ($Y = a + bX$), the lethal concentrations; LC_{50} and LC_{95} (in mg/l) were calculated by substituting Y (in each regression equation) by 5 and 6.64, respectively,

according to Abbott (1925). The least the LC value, the best will be the extract.

RESULTS AND DISCUSSION

Effect of aqueous extract of Gumbail bark on *Anopheles* larvae

The present investigations involved an attempt to determine the potential role of Gumbail extracts as natural products to control mosquito larvae. Seven different concentrations of each extract were used against the tested organisms.

The tested concentrations were: 12, 36, 60, 120, 180, 240 and 300 mg/l and recorded percentage mortality were 12.5, 15, 40, 55, 65, 75 and 82.5 on *Anopheles* larvae, with LC50 and LC95 of 92.88 mg/l and 1054.27 mg/l, Anopheles larvae Table (1).

Generally, several authors recorded superior mosquitocidal effects of nonpolar constituents of some plants extracted with petroleum ether or hexane, attributed mainly to triterpenoids constituents (Mullai and Jebansean, 2007; Abdul Rahuman *et al*., 2008; Abdu Zahhir *et al*., 2009).

The plant high larvicidal activities is supported by presence of phytochemicals such as alkaloids, saponins, flavonoids, steroids and tannins which showed combination effects in terms of larvicdal action to mosquito larvae. Saponins are known by their toxicity to harmful insects (Chaieb, 2010). Flavonoids isolated from water extracts of *Annonasquasma* are effective as insecticides against mosquito (Kotkar *et al*., 2002), alkaloids the activities of these metabolites arise from their biological role in their origin. Some alkaloids act as growth regulators and others as insect's repellants or attractants (Mann, 1987). Terpenes are secondary metabolites essential for the maintenance of life and many of them have physiological effects (Tedder *et al*., 1972). Groups of regular and irregular monoterpenes are used as natural insecticides (Evans, 1989). Phenolic compounds are the wide distribution and more abundant presence of flavonoids in the plant kingdom active against mosquito (Wang *et al*., 2000).

In the past few years, some plant compounds were investigated by several authors for anti-mosquito potential larvicidal activities (Halawa, 2001; Khater, 2003; Saleh, 1995). Plants may be alternative source for mosquito repellent agents since they constitute a rich source of bioactive chemicals (Wink, 1993).

Table (1): Effect of aqueous extract of Gumbail bark on Mosquito larvae.

Concentration		*Anopheles*	
mg/l	Log	Tested mortality	Probit
0	-	0	-
12	1.08	12.5	3.87
36	1.56	15	3.96
60	1.78	40	4.75
120	2.08	55	5.13
180	2.26	65	5.39
240	2.38	75	5.67
300	2.48	82.5	5.95
R^2			0.93
A			1.93
B			1.56
SE-X			0.37
SE-Y			0.185
LC50			92.88 mg/l
LC95			1054.27 mg/l

Y = a + bx
For LC50   Y = 5
For LC95   Y = 6.64

 Effect of aqueous extract of Gumbail leaves on *Anopheles* larvae
  The tested concentrations were: 8, 24, 40, 80, 120, 160 and 200 mg/l and recorded percentage mortality were 17.5, 22.5, 35, 50, 60, 70 and 75 on *Anopheles*larvae, with LC50 and LC95 of 69.23 mg/l and 1653.81 mg/l, Anopheles larvae Table (2).
 A survey of literature on control of different species of mosquito revealed that assessment of the efficacy of different phytochemicals obtained from various plants has been carried out by a number of researches on the field of vector control. Sukumar *et al*., (1991) made an extensive review of botanical derivatives in mosquito control. Plant products can be used, either as insecticide for killing larvae or adult mosquitoes or as repellents for protection against mosquito bites depending on the type of activity they possess (ICMR, 2003).

Table (2): Effect of aqueous extract of Gumbail leaves on Mosquito larvae.

Concentration		*Anopheles*	
mg/l	Log	Tested mortality	Probit
0	-	0	-
8	0.90	17.5	4.08
24	1.38	22.5	4.26
40	1.60	35	4.61
80	1.90	50	5.00
120	2.08	60	5.25
160	2.20	70	5.52
200	2.30	75	5.67
R^2			0.95
A			2.81
B			1.19
SE-X			0.12
SE-Y			0.23
LC50			69.23 mg/l
LC95			1653.81 mg/l

$Y= a + bx$

For LC50   Y=5

For LC95   Y=6.64

Effect of aqueous extract of Gumbail fruits on *Anopheles* larvae

During season 2014 the tested concentrations were: 10, 30, 50, 100, 150, 200 and 250 mg/l and recorded percentage mortalities as 12.5, 15, 45, 60, 70, 77.5 and 80, on *Anopheles* larvae, with LC50 and LC95 of 72.42 mg/l and 802.50 mg/l for *Anopheles* Larvae Table (3).

A large number of plant extracts has been reported to have mosquitocidal or repellent activities against mosquito vectors, but very few plant products have shown practical utility for mosquito control (sukumar *et al*., 1991). Phytochemicals obtained from plants usually have less environmental hazards than synthetic chemicals and this has renewed the interest in the research on phytocom pounds, considering them as ecologically safe alternatives to synthetic insecticides (Isman, 2006).

Table (3): Effect of aqueous extract of Gumbail fruits on Mosquito larvae.

Concentration	*Anopheles*		
mg/l	Log	Tested mortality	Probit
0	-	0	-
10	1	12.5	3.87
30	1.48	15	3.96
50	1.70	45	4.87
100	2	60	5.25
150	2.18	70	5.52
200	2.30	77.5	5.77
250	2.40	80	5.84
R^2			0.93
A			2.08
B			1.57
SE-X			0.19
SE-Y			0.36
LC50			72.42 mg/l
LC95			802.52 mg/l

CONCLUSIONS AND RECOMMENDATIONS:

According to the determined LC50 and LC95 values for aqueous extracts of bark, leaves and fruits of the Gumbail tree were toxic to *Anopheles* larvae.

According to the lethal effect exerted by the extracts of Gumbail, it can be recommended to use these preparations as methods to control mosquitoes.Use of extracts from different localities and different strains of larvae are important to come out with solid LC50 and LC95.To continue investigation on natural products to determine and add any products potential as mosquito larvicides.

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comparative Study of some okra crop cultivars for resistance to powdery mildew caused by *Erysiphe cichoracearum* in south Kordofan (Dalanj Locality)

Dr. Ibrahim Saeed Mohamed
Dr. Jamal Ali Noja
Sami Dahyia Aghbash Mahmoud

Abstract:

Due to the expansion of the cultivation of the okra crop in different region in the state of south kordofan and scarcity of studies on did eases affecting the okra crop, especially powdery mildew disease, this study aimed to find out the extent of resistance of some varieties of the okra to powdery mildew disease caused by *Erysiphe cichoracearum* in south kordofan (Dalanj Locality),during the winter agricultural season (2018/2019) from(October – February).the varieties were planted in an area endemic with the disease in basins , and each basin included 30 plants ,where the incidence and severity of infection varied from on variety to another variety the total infection rate jumueia variety40%, followed by khartoumia (Abu shara) variety with an infection rate 50% ,Then Karri variety with an infection rate 60% give ,Then Plgari variety with an infection rate 80% ,Then Hundi variety with an infection rate 90%, and last Om Krishat variety with an infection rate 100% .The study indicated that the jumueia variety is the most resistant to powdery mildew disease and the most productive variety. followed by khartoumia variety ,Then Karri variety.

الخلاصة

نظراً لتوسع في زراعة محصول البامية في مناطق مختلفة في ولاية جنوب كردفان ولندرة الدراسات عن الأمراض التي تصيب محصول البامية خاصة مرض البياض الدقيقي فقد هدفت هذه الدراسة لمعرفة مدي مقاومة بعض اصناف محصول البامية لمرض البياض الدقيقي المتسبب عن الفطر *Erysiphe cichoracearum* في ولاية جنوب كردفان (منطقة الدلنج) خلال الموسم الزراعي الشتوي (2018/2019) في الفترة من (أكتوبر – نوفمبر). زرعت الأصناف في منطقة موبؤة بالمرض في أحواض وشمل كل حوض علي 30 نبات حيث تفاوتت نسبة الإصابة وشدتها من صنف الي اخر، حيث بلغت نسبة الإصابة في الصنف جموعية 40% تليها الصنف خرطومية (أبوشرا) بنسبة إصابة 50% ثم الصنف كرربنسبة إصابة 60% ثم الصنف بلغاري بنسبة إصابة 80% ثم الصنف هندي بنسبة إصابة 90% وأخيراً الصنف أم

كريشات بنسة إصابة100%. وقد دلت الدراسة بأن الصنف جموعية أكثر الاصناف مقاومة لمرض البياض الدقيقي وأكثر الأصناف إنتاجية تليها الصنف خرطومية ثم الصنف كرري.

Introduction:

Okra crop Co mmon Names: okra,gombo, quimombo, bamya, bamieh, gumboin, lady's finger and okoro (Ndunguru and Rajuba,2004).Scientific Names: *Abelmoschus esculentus* and *Hibiscus esculentus* (Kumar et. al ,2010). Okra is most delicious vegetable relished world over. It belongs to the family malvaceae. It is of African origin and grow extensively in the U.S.A, Africa, Asia, Nigeria, Sudan, Irag, Pakistan, Turkey, Astralia, U.K and other neigh boring countries (Anonymous,2013). Major fungal and viral diseases of okra as: Damping off, vascular wilt, cercospora blight and powdery mildew (Kumar et al.2013). Amongst the fungal disease powdery mildew caused by *Erysiphe cichoracearum* DC is one of the important and of common occurrence, wherever okra crop is grown(Diaz Franco,1999).Most of the okra cultivars are susceptible to Powdery mildew disease and depending upon the age of the plant of the time of infection ,yield losses range between 17 -86.6%(Sirdhar,1989).The disease is favored by low temperature(11-28°C) and dry weather conditions and early infection has more effect on the plant growth and yield than late(Sridhar,1985). Plant disease are one the major constraints in crop production with drastic losses in the quality and quantity of the yield. It is one of the most important traditional vegetables in Sudan used almost in all parts of the country. It is cooked either after being dehydrated or as fresh pods. The dehydrated okra fruits locally known as "Waika" is collected from the wild in the rain-lands of the central, Kordofan and Darfur regions (Mohamed,1991). Apart from introduced varieties such as Clemson spineless and Pusa Swani, there are a number of varieties obtained from local types which include a spiny type called Khartoumia. Other local varieties include Karri, Kassala, Medani, Sinnar and other (Ahmed and Mohamed,1997). Powdery mildew of okra caused by Erysiphe *cichoracearum* DC has become a limiting factor to get economic production in south kordofan state. The disease is wide spread and most destructive to the crop under favorable condition. Due to the expansion of the cultivation of the okra crop in different regions of the state and the

scarcity of studies on the disease that affect it, especially the disease of powdery mildew the aim of this research is to the comparative Study of some okra crop cultivars for resistance to powdery mildew caused by *Erysiphe cichoracearum* in south kordofan.

Material and Methods

Study area:

The study was conducted in southern kordofan state (Dalanj Locality). Durin October - February) the years 2018/2019. The area lies approximately between latitudes 29˚;00-32˚ ;00 East and longitudes 10 ˚;00-12˚ ;00 norths. It Covers an area a bout. 135.000Km^2. The average elevation is 600m above sea (Anonymouns, 2002). (IFAD,2006).

Land Preparation:

The field at the seasons (2018/2019) the land were prepared according to method adopted (disc plough and disc harrow) after that divided in to plots. The size of plots 3* 2.5 m. Each plot contains 3 rows and the distance between the rows 70cm and the distance between the hole 25cm.

Field experiments:

In the season to find out the variety resistant to powdery mildew. 6 varieties of okra were planted in basins and each basin included30plants then 10 plants were selected after flowering stage to know the number of infected plants and the number of infected leaves in each plant.

Variety e.g.:

-   Karri, Plgari, Om Krishat, Hundi, Jumueia and Khartoumia.

Data to be collected at with near survey: At data collect intake infected plant samples, isolates, disease incidence percent, disease severity percent. The percentage of infection for each area was calculated according to the equation percentage of infection = (number of infected plants / total number of plants) 100) (Large 1966).

Result and Discussion: -

Okra is an important vegetable crop grown in almost all the area of the country. Among the fungal disease affecting okra crop. powdery mildew caused by *Erysiphe cichoracearum* is one of the important and common occurrence. Wherever this crop is grown and causes of considerable yield loss. According to the best resistance variety in the conducted field experiments to fixing okra cultivar for resistance to powdery mildew disease caused by *Erysiphe cichoracearum* season (2018/2019), Jumueia

(local) variety 40%. This variety give 0.45 kg/basin. Followed by Khartoumia (Abu shara) variety 50% give the productivity 0.42kg/basin, Then Karri variety 60% give productivity 0.41kg/basin, Plgari variety 80% give productivity0.4kg/basin, Hundi variety 90% give productivity 0.35kg/basin, and last Om Krishat variety 100% give productivity 0.28kg/basin. See table (1) and table (2). the researcher also obtained that the local variety of (Jumueia) okra is more resistant to powdery mildew disease, followed by the (Khartoumia –Abushara) variety, then (Karri) variety.

Table (1):

Mean incidence of powdery mildew disease in Okra corps at different varieties to determine resistant varieties:

varieties	Number of infected plants in varieties										Total	Mean	%
	No 1	No 2	No 3	No 4	No 5	No 6	No 7	No 8	No 9	No 10			
Jumueia	0	2	0	3	0	0	2	0	0	2	9	0.9	40%
Khartoumia	1	2	0	3	2	0	0	2	0	0	10	1	50%
Karri	2	0	3	1	3	0	0	3	3	0	15	1.5	60%
Hundi	3	2	2	2	2	3	2	1	1	0	18	1.8	90%
Plgari	1	1	3	2	3	2	0	3	2	0	17	1.7	80%
Om Krishat	2	3	2	1	1	2	2	1	2	3	19	1.9	100%
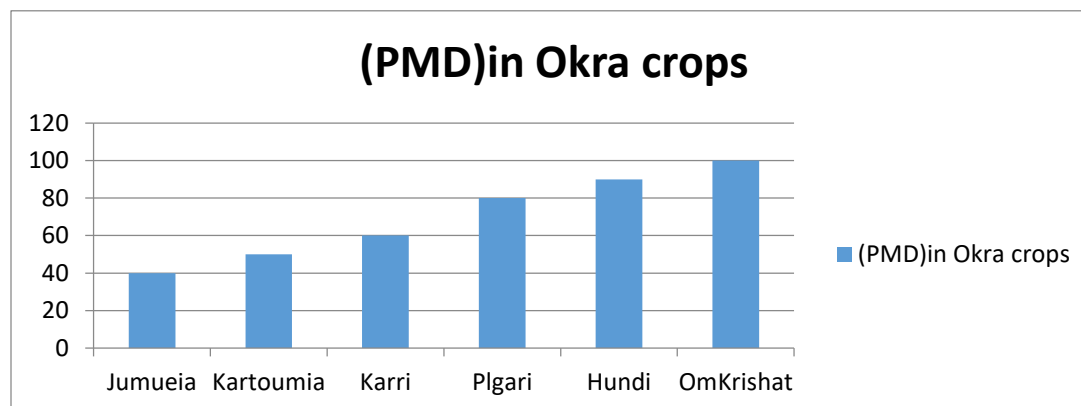
Table (2): Weights (Kg):

Varieties	Weights										Total	Mean
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10		
Khartoumia	0.59	0.40	0.33	0.46	0.56	0.50	0.86	0.20	0.20	0.12	4.22	0.42
Karri	0.56	0.95	0.75	0.22	0.18	0.29	0.33	0.50	0.19	0.12	4.09	0.41
Plgari	0.19	0.18	0.21	0.49	0.30	0.77	0.38	0.65	0.70	0.13	4	0.40
Hundi	0.27	0.49	0.47	0.37	0.32	0.36	0.26	0.45	0.31	0.15	3.45	0.35
Omkrishat	0.16	0.21	0.11	0.11	0.41	0.10	0.31	0.86	0.38	0.10	2.75	0.28
Jumueia	0.55	0.40	0.13	0.50	0.51	0.53	0.60	0.40	0.70	0.17	4.49	0.45

Mean of Weights
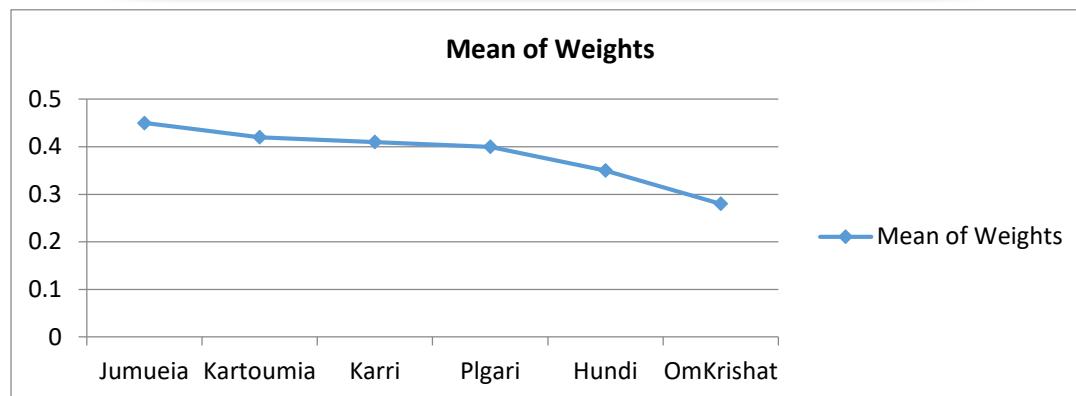
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Evaluation of Seed Filling Problems in Sunflower (*Helianthus annuus* L), as Affected by Pollination and Sowing dates and their Interaction in Tropical Area

Hilwa, D. Abu Anga[1], Wael, A. Marajan[2], Yassin, M. dagash[3] Jamal. A. Noja[4]
  1- Department of Crop Science, College of Agriculture, University of Bahri.
  2- Department of Soil and Water Science, College of Agriculture, University of Bahri.
  3- Department of plant production, faculty of Dalanj University.
Corresponding author: E-mail: waelawad60@yahoo.com. Tel. +249907419605.

ABSTRACT:
The study was conducted during seasons 2014 – 2015 at the College of Agricultural Studies Farm, Sudan University of Science and Technology, Shambat, Khartoum State, Sudan. The main objective of this experiment was to Evaluation of Seed Filling Problems in Local Cultivar of Sunflower (Helianthus annuus L), as Affected by Pollination and Sowing dates in Tropical. The experiment was arranged in factorial with two factors in a randomized complete block design (RCBD) with four replication including two types of pollination and three sowing dates treatments. Statistical analysis (statistic 8 programs) was used to test the effects of treatments on different parameters including vegetative crop characters, yield and yield components. Results revealed that, Pollinations was significant increase the plant height, number of seeds setting per head, number of seeds filling per head, weight of 1000 seeds setting, weight of 1000 seeds filling, head diameter, plant dry weight and yield differed in both seasons. The sowing date was significant increase the sunflower parameters in both seasons including plant height, leaf area, number of seeds setting per head, number of seeds filling per head, weight of 1000 seeds filling, head diameter and plant dry weight in both seasons. The interaction between sowing date and open pollinations application showed the better significant increase on some sunflower growth parameters including plant height, leaf area, number of seeds filling, weight of 1000 seeds filling, head diameter and yield in both seasons compared to cross pollination in combination with sowing date.
Keywords: Sunflower, pollination, sowing date, seed filling, tropical.

INTRODUCTION:

Sunflower (*Helianthus annuus* L.) originated in North America. Now days, Sunflower is one of the most important crops in the world grown as edible oil, after soybean, Rape seed and peanut. Sunflower seed is third largest source of vegetable oil in the world, grown wildly after, soy bean and Palm (Baldini, *et. al.*, 2000). Sunflower is an annual plant that grows up to about 3 meters long. The large and beautiful flowers are capitulum type with diameter of 35cm. It is being grown in most places around the world. The seeds are very nutritious with of 24% proteins, 47% oil, 20% hydrocarbons, 8% phosphorus and 9% potassium, in addition to vitamin A. The oil content is composed of 65% linoleic acid, some phospholipids and vitamin E. For this reason, sunflower seeds are known to be important in lowering blood triglycerides and in regulating blood cholesterol (Khidir, 2007). Seed setting and filling problem is one of the most important constraints in sunflower production and often considered to be a major reason for low productivity (Ram and Davari, 2011).

In Sudan sunflower demonstrated at first time in the demonstration farm of ElGezera Station in1932, after that until 1949 experiments showed that it is a summer crop (growing by farmers in Wad Alnow, Gezera scheme). During season 1952/1951 empty seeds percentage was 90% because of low pollination (Ministry of Agriculture, 2008). Extensive commercial production of sunflower was initiated in Sudan in the late 1980's and the early 1990's with the introduction of hybrids such as Hysun-33 from Australia and PAN-7351 from South Africa (El Ahamdi, 2003; Nour, *et. al*., 2005). The production was established mainly in rain fed areas of the country and, to a lesser extent in irrigated conditions. At about the same time, early maturing accessions of two open-pollinated sunflower varieties, Rodio and Bolereo, were released under the names Damazin-1 and Damazin-2, respectively (Adam and Osman, 1989).

Sunflower is categorized as a low to medium drought sensitive crop (Iqbal, *et al*. 2005). All over the world, Sunflower production in the countries which have temperate regions is higher than the tropical. Sunflower can grow on different types of soils but its performance is better in soils best for the growth of maize and wheat. Among the cash

crops, sunflower is one of the crops having shortest growing season around the world.

Sunflower can be planted at a wide range of dates, as most cultivars are earlier in maturity than the length of growing season in most areas. In areas of the world with no winters, sunflower has been planted at any month of the year to obtain satisfactory yields (Joksimovic, *et. al*., 1999; Vega and Hall. 2002).

Cross-pollination may still be preferred; however, as it appears to give higher yields and better quality in terms of oil content. Fertility of self-pollen may be greatly reduced at high temperatures, which increases the importance of prompt pollination of self-pollinated varieties during hot weather (Machado, 2006).

The objectives of this study are:

a- To evaluate the seed filling problems in local cultivar of sunflower in tropical area.

b- To select the best pollination and sowing date that increases the filling efficiency.

MATERIALS AND METHODS:

The experiment was conducted at the College of Agricultural Studies Farm, Sudan University of Science and Technology, Shambat, Khartoum State, Sudan, during seasons 2014 - 2o15. Latitude 15º 40' N, Longitude 32º 32' E and 375 m above sea level. The climate is described as tropical semi-arid. The maximum annual rainfall ranges about 160 mm, occurring during July to September. Relative humidity ranges between 31-51% during wet season and 12-27% during dry season. Mean maximum and minimum temperature in Khartoum are 41.7^0 C and 15.3^0 C respectively. The winter from November to March is relatively cool and dry. The summer season is hot and rainy.

The soil of study area is classified as silty clay loam with non-saline at surface and non-saline slightly sodic at subsurface which make it ideal for vegetable and crop production.

The experimental design was a factorial with two factors in Randomized Complete Block with four replicates including open and close pollinations which referred to as OP, CP. and three sowing dates (March, May and July) which referred to as S1, S2 and S3 respectively. Plot size

was 4 × 4m with 5 rows each of them, 70cm spacing between the ridges and intra spacing between the plants was 15 cm.

The land was prepared by using a suitable seedbed implements disc plough, disc harrow and leveler. Three plants were randomly selected from each plot and measured the vegetative parameters concerning plant height (cm), leaf area index, plant dry weight (g), yield and yield components including Head diameter. 100 seeds weight (g), number of seeds/head, yield (t/ha). The data collected were subjected to analysis of variance and means were separated for significance by the least significance differences (L.S.D) at *P* 5% using statistical 8 Version 2.0 (UK).

RESULTS AND DISCUSSION

Table 1: Effect of pollinations on Plant height (cm), leaf area (cm^2), Number of setting seed/head and Number of filling seed/head of sunflower (*Helianthus annuus* L) during seasons (2014 and 2015).

Season I				
Pollination	Plant height (cm)	Leaf area (cm^2) L. A. I.	Number of setting seed/head	Number of filling seed/head
OP	117.30^a	107.79^a	344.2^a	167.5^a
CP	113.62^b	104.91^a	294.4^b	156.3^a
SE+	3.30	4.45	24.62	12.76
CV	6.72	9.06	30.77	25.96
Season II				
OP	115.16^a	104.11^a	612.3^a	211.7^b
CP	114.31^a	106.74^a	218.6^b	381.2^a
SE+	2.52	5.39	20.01	30.04
CV	5.11	10.96	31.78	35.35

Means in columns followed by different letters are significantly different at 5 %. OP = open pollination. CP = cross pollination.

Table 2: Effect of pollinations on Weigh of 1000 seeds filling (g), Weight of1000 seeds setting(g), head diameter (cm), Plant dry weight (g) and Yield t/ha of sunflower (*Helianthus annuus* L) during seasons (2014 and 2015).

Season I					
Pollination	Weigh of 1000	Weightof1000 seeds filling(g)	head diameter (cm)	Plant dry weight (g)	Yield t/ha

	seeds setting(g)				
OP	42.3[b]	13.5[b]	9.92[a]	398.3[b]	1.42[a]
CP	47.5[a]	15.7[a]	8.92[b]	436.7[a]	1.40[a]
SE+	**2.50**	**0.13**	**0.36**	**23.00**	**0.08**
C.V	**5.00**	**0.26**	**0.73**	**35.15**	**0.16**
Season II					
OP	55.3[a]	14.3[a]	10.69[a]	215.4[b]	3.9[a]
CP	51.7[b]	12.2[b]	9.93[b]	268.3[a]	2.0[b]
SE+	**2.80**	**0.12**	**0.34**	**28.97**	**0.15**
C.V	**5.60**	**0.23**	**0.69**	**38.94**	**0.31**

Means in columns followed by different letters are significantly different at 5 %. OP = open pollination. CP = cross pollination.

Table 3: Effect of sowing dates on Plant height (cm), leaf area (cm^2), Number of setting seed/head and Number of filling seed/head of sunflower (*Helianthus annuus* L) during seasons (2014 and 2015).

Season I				
Sowing date	Plant height (cm)	Leaf area (cm^2) L. A. I.	Number of setting seed/head	Number of filling seed/head
S1	120.63[a]	106.82[b]	186.3[c]	228.4[a]
S2	110.13[c]	88.66[C]	293.3[b]	97.8[c]
S3	115.63[b]	117.56[a]	478.4[a]	159.4[b]
SE+	**4.04**	**6.51**	**24.64**	**15.63**
CV	**8.23**	**11.10**	**37.17**	**31.79**
Season II				
S1	117.96[a]	79.35[b]	337.9[b]	223.7[c]
S2	109.57[b]	120.50[a]	415.7[ab]	270.7[b]
S3	116.66[a]	116.42[a]	493.3[a]	394.9[a]
SE+	**3.08**	**6.60**	**27.99**	**25.36**
CV	**6.26**	**13.42**	**35.37**	**32.29**

Means in columns followed by different letters are significantly different at 5 %. S1= Sowing in March. S2= Sowing in May. S3= Sowing in July.

Table 4: Effect of sowing dates on Weigh of 1000 seeds filling (g), Weight of1000 seeds setting (g), head diameter (cm), Plant dry weight (g) and Yield t/ha of sunflower (*Helianthus annuus* L) during seasons (2014 and 2015).

Season I					
Sowing date	Weigh of 100 seeds setting (g)	Weightof100 seeds filling(g)	head diameter (cm)	Plant dry weight (g)	Yield t/ha

S1	46.4[a]	07.8[c]	8.29[b]	366.3[b]	1.3[b]
S2	43.7[a]	16.7[b]	9.92[a]	532.5[a]	1.1[c]
S3	44.6[a]	19.2[a]	10.04[a]	353.8[b]	1.9[a]
SE+	**3.00**	**0.16**	**0.44**	**20.42**	**0.10**
C.V	**6.10**	**0.32**	**0.89**	**32.19**	**0.20**
Season II					
S1	50.9[b]	14.8[a]	8.46[c]	215.0[b]	1.9[b]
S2	61.4[a]	12.9[b]	11.48[a]	191.9[b]	2.8[a]
S3	48.3[b]	12.3[b]	11.00[b]	318.8[a]	2.8[a]
SE+	**3.40**	**0.14**	**0.41**	**25.48**	**0.17**
C.V	**6.90**	**0.29**	**0.84**	**32.24**	**0.34**

Means in columns followed by different letters are significantly different at 5 %. Local cultivar. S1= Sowing in March. S2= Sowing in May. S3= Sowing in July.

Table 5: Effect of interaction between pollinations and sowing dates on Plant height (cm), leaf area (cm^2), Number of setting seed/head and Number of filling seed/head of sunflower (*Helianthus annuus* L) during seasons (2014 and 2015).

Season I								
Pollination	**Plant height (cm)**		**Leaf area (cm^2)**		**No. of setting seeds/head**		**No. of filling seeds/head**	
Sowing date	**OP**	**CP**	**OP**	**CP**	**OP**	**CP**	**OP**	**CP**
S1	125.0[a]	116.3[a]	107.8[b]	105.8[b]	218.5[b]	154.0[b]	231.1[a]	225.7[a]
S2	111.1[c]	109.2[b]	84.8[c]	92.6[c]	253.8[b]	332.8[a]	84.9[c]	110.9[c]
S3	115.6[b]	115.4[a]	118.8[a]	116.3[a]	560.3[a]	396.5[a]	186.7[b]	132.2[b]
SE+	**5.72**		**7.71**		**27.28**		**22.1**	
CV	**11.64**		**15.69**		**37.22**		**34.9**	
Season II								
S1	118.4[a]	117.5[a]	84.9[b]	73.78[b]	516.1[b]	159.9[b]	176.6[b]	270.8[c]
S2	109.9[b]	109.2[b]	116.6[a]	124.4[a]	662,1[a]	169.5[b]	202.6[ab]	338.8[b]
S3	117.1[a]	116.3[a]	110.8[a]	122.0[a]	660.1[a]	326.5[a]	255.9[a]	534.0[a]
SE+	**4.35**		**9.33**		**28.6**		**24.1**	
CV	**8.25**		**18.98**		**31.9**		**30.9**	

Means in columns followed by different letters are significantly different at 5 %. Local cultivar. S1= Sowing in March. S2= Sowing in May. S3= Sowing in July.

Table 6: Effect of interaction between pollinations and sowing dates on Weigh of 1000 seeds filling(g), Weigh tof1000 seeds setting (g), head

diameter (cm), Plant dry weight (g) and Yield t/ha of sunflower (*Helianthus annuus* L) during seasons (2014 and 2015).

Season I										
Sowing date	Weigh of 1000 seeds setting(g)		Weightof1000 seeds filling(g)		head diameter (cm)		Plant dry weight (g)		Yield t/ha	
	OP	CP	OP	CP	OP	CP	OP	CP	OP	CP
S1	41.7^a	51.2^a	0.67^c	0.91^b	8.18^c	8.42^b	407.5^a	325,0^b	1.2^b	1.3^b
S2	44.3^a	43.1^c	1.42^b	1.92^a	11.00^a	8.84^b	455.0^a	610.0^a	1.0^c	0.1^c
S3	41.0^a	48.3^b	1.96^a	1.88^a	10.58^b	9.50^a	332.5^b	375.0^b	2.0^a	1.7^a
SE+	4.30		0.22		0.62		23.17		0.098	
CV	9.80		0.46		1.26		37.3		0.340	
Season II										
S1	51.8^b	50.0^b	1.68^a	1.28^a	9.90^c	7.03^b	158.8^b	271.3^b	2.4^c	1.4^c
S2	63.8^a	59.0^a	1.38^b	1.20^a	11.60^a	11.35^a	200.0^b	183.8^c	3.6^a	2.0^b
S3	50.5^b	46.0^b	1.25^c	1.18^a	10.58^b	11.43^a	287.5^a	350.0^a	3.0^b	2.6^a
SE+	4.80		0.11		0.59		20.18		0.21	
CV	8.70		0.41		1.19		30.10		0.43	

Means in columns followed by different letters are significantly different at 5 %. Local cultivar. S1= Sowing in March. S2= Sowing in May. S3= Sowing in July.

Regarding table 1, the results of data analysis of this study showed variation in plant height for the different types of pollination in the same season as well as between the two seasons. Considering the first season, open pollination has significant increased plant height (117.30 cm) compared to cross pollination (113.62 cm), compared to the second season where the plant heights for the different pollinations were 115.16 cm, and 114.31 cm for open and cross pollination respectively without significant differences. It is clear that open pollination (OP) produced the highest plant height in both seasons. This variation in the plant heights in different seasons may be due to climatic differences. In other hand no significant differences were observed between the two types of pollination on leaf area index (LAI) in both seasons. This result may be due to the relationship between leaf area indexes (LAI) and pollination and the effect of the environmental conditions prevailing in the area.

As well as the number of seed be setting per head, different types of pollinations showed significant increase within and between the seasons. In the first season, OP (344.2) exceeded the other pollination, namely CP (294.4), compared to (612.3) and (218.6) for open and cross pollination

in the second season respectively. It is clearly that number of seed setting for the second season is better than for the first season due to open pollination. As for as no significant increase was observed between the number of seed filling per head due to types of pollination in season one, whereas the cross pollination (381.2) has significant increase in number of seed filling per head compared to open pollination (211.7) in season two. It is clearly that number of seed filling for the second season increased than for the first season. This result may be attributed to difference in irrigation applications between the two seasons. Machado, (2006) reported that, it was a major cause for empty achiness in sunflower plants grown under non-stress conditions. seed set as low as 10-20% results when pollinators are absent and plants self-pollinate, compared up to 90% seed set in flower heads accessible to pollinators. Seed set was significantly affected by pollination treatment. (Agustín, *et. al.,* 2018).

The results given in table 2, including weight of 1000 seed setting, weight of 1000 seed filling, head diameter and Plant dry weight showed significant differences within and between the seasons. Cross pollination gave the highest values of weight of 1000 seeds setting and weight of 1000 seeds filling significantly in season one. However, the open pollination showed significant differences between the pollination types on weight of 1000 seeds setting and weight of 1000 seeds filling in season two. The results might be due to the environmental conditions and the amount of irrigation applications.

In regard to head diameter, the effect of pollination on head diameter revealed significant increase obtained by open pollination treatment compared to cross pollination in both seasons. Considering the first season, open pollination has significant increased head diameter (9.92 cm) compared to cross pollination (8.92 cm), compared to the second season whereas significantly increase the head diameter for the different pollinations were (10.69 cm) and (9.93 cm) for open and cross pollination respectively, which may be depending on the amount of water applied and environmental conditions between the seasons. Other researchers have also observed that head diameter showed differences in different years depending on climatic factors (Hashim and Schneiter, 1987; Ozer, *et al.,* 2003).

Regarding the Plant dry weight, cross pollination significantly increased plant dry weight (436.7 g) compared to open pollination (398.3 g) in first season and compared to the second season whereas significantly increase on plant dry weight for the different pollinations were (268.3 g) and (215.4 g) for cross and open pollination respectively. It is clear that season one including two of pollinations produced the highest plant dry weight compared to season two.

In regard to plant yield open pollination had significant increase yield (3.2 t/ha) in second season compared to cross pollination (2.0 t/ha) and compared to first season (1.42 t/ha) and (1.40 t/ha) for open and cross pollination respectively without significant differences between them. Agustín, *et. al*., (2018), demonstrate that cross-pollination improves seed set of sunflower, resulting in higher yields per ha.

Including the data's in table 3, Sowing date applications in both seasons showed significant differences on plant height. However, S1 treatment revealed the highest plant height (120.6 cm) significantly compared to S3 (115.6 cm) and S2 (110.1 cm) respectively in season one, compared to second season when S1 (118.0 cm) and S3 (116.7 cm) significant increase plant height compared to S2 (109.6 cm) in season two, that may be to differences in environmental conditions between the seasons. It is clear that season one produced the highest plant highest compared to season two.

As for as the leaf area index (LAI) concern, in the first season, sowing date S3 produced bigger LAI (117.6 cm^2) compared to S1 (106.1 cm^2) and S2 (88.7 cm^2) respectively. While in the second season; S2 produced the biggest LAI (120.5 cm^2), followed by S3 (116.4 cm^2) and S1 (79.4 cm^2) respectively. Ogunemi, (2000) reported that, optimum sowing date of sunflower as early and late season crops is relatively well known to be late May and July – Early August, respectively in the forest–savanna transition zone.

In regard to number of setting seeds per head showed significantly increase due to sowing date applications. S3 (478.4) and (493.3) a chive the higher number of setting seed per head in both seasons respectively followed by S2 (293.3), (415.7) and S1 (186.3), (337.9). It is clear that second season produced the highest number of setting seeds per head compared to first season.

Regarding the number of filling seeds per head sowing date treatment was showed significant increase in season one obtained by S1 (228.4) compared to S3 (159.4) and S2 (97.8), while in second season S3 treatment revealed the highest rate number of filling seeds per head compared to S2 (270.7) and S1 (223.7) respectively. Villalobos (1996), reported that, the number of grains per head is influenced by environmental conditions during the pollination period.

Considering table 4, the results of data analysis of this study showed increased in thousand setting seeds weight for the different sowing dates in the same season as well as between the two seasons. Considering the first season, sowing in S1 has increased thousand setting seeds weight (46.4 g) compared to S3 (44.6 g) and S2 (43.7 g), without significant effect compared to the second season where the thousand setting seeds weight for the different sowing dates were 50.9 g, 61.4 g and 48.3 g for January, May and July respectively. It is clear that sowing date (S_1) produced the highest thousand setting seeds weight in both seasons.

In regard to thousand weight of seeds filling showed significant increase in both season, the significant increase in first season obtained by S3 (19.2 g) compared to S2 (16.7 g) and S1 (07.8 g), whereas second season showed significant increase, when S1 (14.8 g) showed the highest weight compared to S2 (12.9 g) and S3 (12.3 g) respectively. This result may be due to high temperatures that affected the rate of plant development and reduced length of the reproductive period. Nihal (2010), reported that higher temperature reduced vegetative growth and enhanced flowering. Regarding to head diameter there was significant differences were observed in both seasons. However, S3 (10.04 cm) and S2 (9.92 cm) significantly increased the head diameter compared to S1 (8.29 cm) in first season. Different sowing dates were significant increase S2 (11.48 g), compared to S3 (11.00 g) and S1 (8.46 g). Tanimu, *et. al.,* 1991. Reported that delay in sowing date significantly reduces the head diameter. Esechie (2008), showed that, head diameter, increased with delay in planting date.

Result showed that, plant dry weight was significant increase due to applications of sowing date within season one, S2 (532.5 g) was obtained the highest value compared to S1(366.3 g) and S3 (353.8 g), and compared to season two the significant increase in plant dry weight

obtained by S3 (318.8 g) compared to S1 (215.0 g) and S2 (191.9 g) respectively. Thompson and Heenan (1994) reported that dry matter production has been affected by sowing date. Time of sowing has great influence on dry matter accumulation, (Sofield, 1977).

Sowing date applications was affected the sunflower yield when the S3 recorded (1.9) t/ha significantly flowed by S1 recorded (1.3) t/ha compared to S2 (1.1) t/ha in first season, in second season S3 and S2 recorded the highest yield (2.8) t/ha significantly compared to S1 (1.9) t/ha. It is clear that second season produced the highest yield compared to first season this may be due to differences in environmental conditions Allam, *et. al.,* (2003), reported that, planting date exerted significant influence on yield and its components. Seed yield generally decreased with delayed sowing which might be attributed to the decrease in yield components (Siddique, *et. al.,* 2002).

The interaction between sowing date and pollinations treatments and their effect on plant height in table (5) showed significant differences among the treatments. However, S1 in combination with both open and close pollination obtained the highest rate of plant height compared to S2 and S3 in both seasons. Leaf area index revealed that, there were significant differences between the treatments observed due to interaction between sowing date and pollination treatments. S3 in first season showed significant increase on leaf area compared to S1 and S2 respectively, when S3 and S2 significantly increased the leaf area index compared to S1 treatment.

The significant differences in sowing dates in season one and the non-significant difference in season two may be due to the relation between leaf area and pollination and the effect of sowing date and environmental conditions prevailing in the area.

The data revealed that, the interaction between sowing date and both pollinations treatments were affected the number of setting seeds per head. The interaction between S3 and OP increase the number of setting seeds compared to S2, and S1in first season, when S2 with OP raise the highest number of setting seeds followed by S3 significantly compared to S1. However, this interaction between sowings and OP showed increased in setting seeds per head compared to interaction of sowing date with CP in both seasons, while the interaction between sowing date

and close pollination showed increased in filling seeds per head compared to OP interaction. Whereas S1 in combination with both pollinations obtained the highest rates of filling seeds in first season one. In season two S3 in combination with both pollinations obtained the highest rates of filling seeds compared to other interaction treatments. These results may be due to difference in irrigation between the two seasons. It was a major cause for empty achiness in sunflower plants grown under non-stress conditions.

Considering table (6) no significant effect was observed on weight of 1000 seed setting due to interaction between sowing date and OP in first season, but the interaction of S2 with OP showed significant increase in weight of 1000 seed setting compared to S1 and S3, while the interaction of sowing and CP revealed significant increase in weight of 1000 seed setting obtained by S1 in season one and S2 in season two compared to other treatments. In other hand, the interaction showed significant increase in weight of 1000 seed filling in both seasons obtained by the combination of S3 and OP in season one and S1 with OP in season two, whereas, S2 and CP obtained the highest weight compared to other interactions in first season and there was no significant effect observed on weight of 1000 seed filling in second season due interaction of sowing date with CP. Machikowa and Saetang (2008) reported significant positive correlations between head diameter and 1000-seed weight.

The significant differences were observed on head diameter in both seasons due to interaction of sowing date and two types of pollinations in both seasons. Also the plant dry weight was affected significantly due to the interaction between the treatments, when S2 with OP and CP obtained the highest value of plant dry weight in first season, while the S3 in combination with OP and CP obtained the highest value in season two. Head diameter is very important trait in the sunflower seed yield structure. The size of the head diameter influences the number of flowers and seeds per head which directly influence the seed yield per plant. Head size should be intermediate.

Regarding the interaction between the two factors showed that, S3 in combination with two types of pollinations recorded significantly (2.0) t/ha for OP and (1.7) t/ha for CP in first season. Whereas second season recorded (3.6) t/ha and (2.6) t/ha for S2 in combination with OP and S3

in combination with CP as the highest rates of plant yield respectively compared to other treatments. It is clear that second season produced the highest yield compared to first season this may be due to differences in environmental conditions

CONCLUSION

Pollinations were significant increase the plant height, number of seeds setting per head, number of seeds filling per head, weight of 100 seeds setting, weight of 100 seeds filling, head diameter plant dry weight and yield differed in both seasons.

The sowing date was significant increase the sunflower parameters in both seasons including plant height, leaf area, number of seeds setting per head, number of seeds filling per head, weight of 100 seeds filling, head diameter, plant dry weight and yield in both seasons.

The interaction between sowing date and open pollinations application showed the better significant increase on some sunflower growth parameters including plant height, leaf area, number of seeds filling, weight of 100 seeds filling, head diameter and yield in both seasons compared to cross pollination in combination with sowing date.

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Quantum effects of constant magnetic field on orthohydrogen molecules

Taha Yousif, Wenjun Zhou, and Ling Zhou
Department of Physics, Dalanj University, Dalanj, Sudan
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Abstract

We investigate the effect of magnetic field **B** on a beam of orthohydrogen molecules polarized in the x direction. First we explained that the spin state of protons and neutrons $\psi(t)$ is an eigenstate of the operator S_ρ , corresponding to the component of spin angular momentum. We also showed that the fraction of molecules emerging from the three output channels of second magnet in Stern-Gerlach apparatus corresponding Ms=1, 0, -1 are proportional to probability coefficients, and then we deduced the value of the magnetic moment of the proton (μ_p) in nuclear magnetron. Finally, we compare our results with the classical picture for processing gyroscope which showed well agrees with the obtained one.

Key words: Orthohydrogen, Ster-Gerlach, Proto spin, gyroscope Lambor frequency

المستخلص:

في هذه الدراسة تم أستقصاء الأثر الذي يُحدثه المجال المغناطيسي في حزمة من الجزيئات الهيدروجينية الموضوعة في القراغ علي طول محور x. في البدء تم توضيح أن الدالة الموجية للجزيئات $\psi(t)$ هي دالة مميزة لمؤثر اللف المغزلي المناظر للعزم الزاوي المغزلي والذي يُرمز له بالرمز $\hat{S}_\rho$.

وقد أوضحت الدراسة أن عدد الجزيئات (البروتونات) التي تعبر المجال المغناطيسي الثاني لجهاز (أسترن– غيرلج) والمقابلة لقيم اللف المغناطيسي المغزلي Ms = 1, 0, −1 يتناسب مع السعة الكلية لمعاملاتها، ومن ثم تم استنباط وحساب قيمة العزم المغناطيسي للبروتون. أخيراَ قُورنت النتائج المتحصل عليها مع النتائج الكلاسيكية السابقة وقد أظهرت توافقاَ معها لقيم تردد لارمور والنسبة الجيرمغناطيسية. وتعتبر هذا النتائج ذات أهمية كبيرة لا سيما في الحسابات النووية الدقيقة.

Introduction:

Orthohydrogen molecules are the dihydrogen molecules containing hydrogen atoms with a nucleic spin in the same direction. In other words, the spin of two atoms is aligned parallel to each other, which means that it is a spin isomer of para hydrogen [1-5].

Recently a strong interest in orthohydrogen molecules within Stern-Gerlach apparatus (SGE) has been stimulated by progress in many experimental systems [6-10], which could be used for probing fundamental questions in quantum mechanics and for high-sensitivity instruments in general. Proposed experiments include Stern-Gerlach for detecting the movement of protons or (neutrons) through magnets [11-13], quantum superposition [14], and many others, all realized in the relatively massive mechanical degree of freedom of a micro-mechanical system [15].

Among those experiments, orthohydrogen molecules play a central role in devices and experiments ranging from electromagnetic theory to laser and other quantum mechanical approaches for emerging molecules detection [16]. These experiments rely, in general, on the investigating the movement of charged particles in magnetic fields. Using this method, it is possible to investigate the effects of a wide number of molecules. As it is well known, atoms, in general, are made up of nucleus and many electrons with no net angular momentum. If we ignore the nuclear spin, which is irrelevant to our discussion here, we see that the atom as whole does have an angular momentum, which is due solely to the spin intrinsic as opposed to orbital–angular momentum of the single electron. Orthohydrogen molecule is any free neutron or proton (that is not bound within an atomic nucleus) that has an average energy of motion (kinetic energy) corresponding to the average energy of the particles of the ambient materials, relatively slow and of low energy, it exhibit properties such as large cross sections in fission, which make them desirable in certain chain-reaction applications [17]. Furthermore, the long de Broglie wavelengths of orthohydrogen molecules make them valuable for certain applications of quantum optics [18]. These particles are produced by slowing down more energetic protons and neutrons in a substance called a moderator after they have been ejected from atomic

nuclei during nuclear reactions such as fission [19]. Quantitatively, the thermal energy per particle is about 0.025 eV with an amount of energy that corresponds to a neutron speed of about 2,000 metres per second and a neutron wavelength of about (2×10^{-10} metre) (or about two angstroms) [20]. Because the wavelength of orthohydrogen molecules corresponds to the natural spacing between atoms in crystalline solids, beams of these particles are ideal for investigating the structure of crystals, particularly for locating positions of hydrogen atoms, which are not well located by X-ray diffraction techniques [20]. Also, orthohydrogen molecules are required for nuclear calculations [19].

Although some schemes for this kind of experiments have been done [21], the answer to the question whether some of the particle can emerge through the second magnetic field in SGE apparatus is yet unclear. In this paper, we demonstrate the effect of constant and inhomogeneous magnetic field in orthhydrogen molecules. The motivations for exploring this aspect include the study of spin properties of orthhydrogens, by exploring the quantum motion and their spin properties.

The rest of this paper is organized as follows. In Sec. II, we introduce the physical model and the Stern – Gerlach apparatus. In Sec. III, we investigate the spin operator of the system. In Sec. IV we introduce the spin of Pauli operators and derive their eigenfuctions. In Sec V, we study the properties of protons as orthohydrogen molecules. Sec. VI is devoted to the discussion. Finally, we provide a brief conclusion in Sec. VII.

The model:

In this work we consider a beam of orthohydrogen molecules (proton spin state S=1), traveling along the y axis, passes through a stern-Gerlach apparatus with its magnetic field along the x axis. The emerging molecules with $Ms = 1$ are passed through a second Stern- Gerlach apparatus with its magnetic field along the x axis. A constant magnetic field B in the z direction acts along part of the path between the two magnets, see Fig (1).

Fig.(1): Geometry of the system (Stern- Gerlach apparatus). Taha Yousif
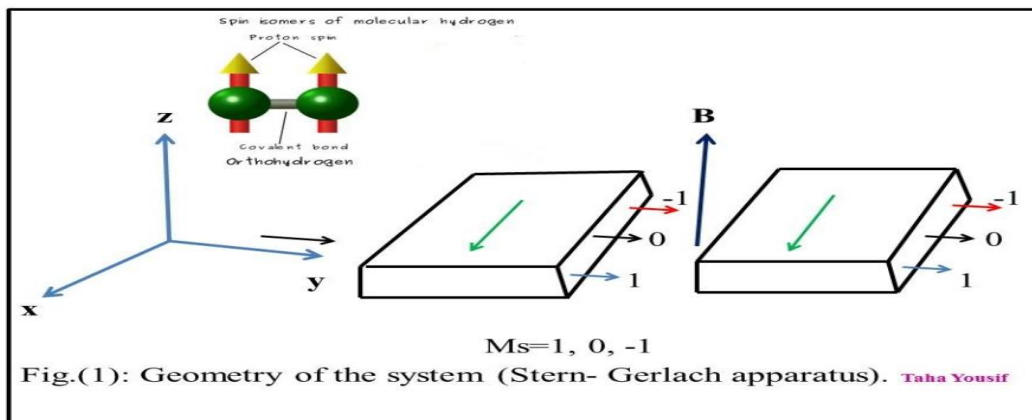
Spin operators:

The operators corresponding to the x, y, z components of spin angular momentum are denoted by S_x, S_y, S_z, and the operator S^2 which is corresponds to the square of the magnitude of the spin angular momentum.

Where $S^2 = S_x{}^2 + S_y{}^2 + S_z{}^2$. The commutation relations for S^2, S_x, S_y, and S_z are the same as for the orbital angular momentum operators. The pattern of the eigenvalues of the common eigenfunctions of the operator S^2, S_z is also the same as for orbital angular momentum, but the quantum number ℓ, is denoted by s for spin angular momentum, and it can take half integral values, i.e.

$s = 0, \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, \dots$

For given spin number s the quantum number m, denoted by ms, takes values

$ms = s, s - 1, s - 2, \dots, -(s - 1), -s$. For a single electron, s takes only the value $\frac{1}{2}$ with ms $= \pm \frac{1}{2}$.

The two eigenfunctions are denoted by α and β.

Thus

$S^2 \alpha = s(s + 1)\hbar^2 \alpha, \ S^2 \beta = s(s + 1)\hbar^2 \beta \quad s = \frac{1}{2}$ ……………... (1)

$S_z \alpha = \frac{1}{2}\hbar \alpha, \qquad S_z \beta = -\frac{1}{2}\hbar \beta.$ ………………. (2)

Unlike the orbital angular momentum, the spin operators are defined only by relations such as (1) and (2).

If we consider the case of spin $s = \frac{1}{2}$, where there are two eigenfunctions or unit vector, α and β, so the Hilbert space for this case is two-dimensional. The spin state $\gamma = a\alpha + b\beta$, where a and b are numbers, may be represented as a vector in the space with coordinates a, and b. The numbers a and b are in general complex.

Since α and β are not functions of space, we cannot use (1) to calculate a matrix representation for the spin operator S_ρ. Instead we defined a quantity, known as the scalar product of two state-vector γ_1 and γ_2, and use the Dirac notation to denote it by $\langle \gamma_1, \gamma_2 \rangle$, This definition is an operational one, that is to say it gives the rules for calculating the scalar product, which is, in general, a complex number. The scalar product of α (or β) with itself is unity, while the scalar product of α and β is zero. Thus

$\langle \alpha, \alpha \rangle = \langle \beta, \beta \rangle = 1$ $\langle \alpha, \beta \rangle = \langle \beta, \alpha \rangle = 0$. .... (3)

In the usual language we say that α and β are normalized and orthogonal to each other. The scalar product of $\gamma_1 = a_1\alpha + b_1\beta$ and $\gamma_2 = a_2\alpha + b_2\beta$ is then defined to be

$\langle \gamma_1, \gamma_2 \rangle = \langle a_1\alpha + b_1\beta, a_2\alpha + b_2\beta \rangle$
$\quad = a^*_1 a_2 \langle \alpha, \alpha \rangle + a^*_1 b_2 \langle \alpha, \beta \rangle + b^*_1 a_2 \langle \beta, \alpha \rangle + b^*_1 b_2 \langle \beta, \beta \rangle$
$\quad\quad = a^*_1 a_2 + b^*_1 b_2$ .... (4)

One can see that the definition follows from equal. (4), with extra condition that the numbers in the first vector are replace by their complex conjugates. The matrix element A_{mn} for spin operator $\hat{A}$ is defined by $A_{mn} = \langle m / \hat{A} n \rangle$ where m and n are α or β, so the matrix has dimensions 2×2. If $\hat{S}$ is the operator corresponding to a spin observable σ, then the expectation value of $\hat{S}$ for the state γ is

$\langle \hat{S} \rangle = \langle \gamma / \hat{S} / \gamma \rangle$.

The method is readily extended to higher spin values. Thus for s=1, there are 2s+1=3 normalized and mutually orthogonal spin eigenfunctions or state vectors. The Hilbert space is three dimensional, and the matrix representing a spin operator has dimensions 3×3, and so on.

Pauli spins operator's eigenfunctions:

The Pauli spin operators σ_x, σ_y, σ_z are defined in terms of the spin angular momentum operators S_x, S_y, S_z by $\sigma_x = \frac{2S_x}{\hbar}$ and similarly for y

andz. If we consider the case $s=\frac{1}{2}$, and denote the normalized eigenfuctions of S_z by α and β. Using the relations for raising and lowering operators

$$S_+\phi_{s,m_s} = \{s(s+1) - m_s(m_s+1)\}^{\frac{1}{2}}\hbar\phi_{s,(m_s+1)}, \quad \dots\dots\dots\dots\dots \quad (5)$$

$$S_-\phi_{s,m_s} = \{s(s+1) - m_s(m_s-1)\}^{\frac{1}{2}}\hbar\phi_{s,(m_s-1)} \quad \dots\dots\dots\dots\dots (6)$$

For $s = \frac{1}{2}$

$\alpha = \phi_{\frac{1}{2},\frac{1}{2}}$ and $\qquad \beta = \phi_{\frac{1}{2},-\frac{1}{2}}$ gives

$$S_+\alpha = 0, \qquad S_+\beta = \hbar\alpha, \quad \dots\dots\dots\dots\dots\dots \quad (7)$$

$$S_-\alpha = \hbar\beta, \qquad S_-\beta = 0. \quad \dots\dots\dots\dots\dots \quad (8)$$

Now

$$S_x = \frac{1}{2}(S_+ + S_-), \quad S_y = -\frac{1}{2}i(S_+ - S_-). \quad \dots\dots\dots\dots \quad (9)$$

Therefore

$$S_x\alpha = \frac{1}{2}\hbar\beta, \qquad S_x\beta = \frac{1}{2}\hbar\alpha, \qquad \dots\dots\dots\dots \quad (10)$$

$$S_y\alpha = \frac{1}{2}\hbar\alpha, \qquad S_y\beta = -\frac{1}{2}i\hbar\alpha, \qquad \dots\dots\dots\dots \quad (11)$$

Since α and β are eigenfunctions of S_z with eigenvalues $\pm\frac{1}{2}\hbar$, we also have

$$S_z\alpha = \frac{1}{2}\hbar\alpha, \qquad S_z\beta = -\frac{1}{2}\hbar\beta. \qquad \dots\dots\dots\dots \quad (12)$$

The Pauli spin operators are defined by $S_x = \frac{\hbar}{2}\sigma_x, etc.$ Therefore

$$\sigma_x\alpha = \beta, \quad \sigma_y\alpha = i\beta, \quad \sigma_z\alpha = \alpha, \qquad \dots\dots\dots\dots \quad (13)$$

$$\sigma_x\beta = \alpha, \quad \sigma_y\beta = i\alpha, \quad \sigma_z\beta = -\beta \qquad \dots\dots\dots\dots \quad (14)$$

Since

α and β are normalized, the eigenfunctions of σ_x and σ_y are normalized by the factor $\frac{1}{\sqrt{2}}$. The eigenvalues follow from inspection of (12).

Using the matrices $\hat{\sigma}_x, \hat{\sigma}_y, \hat{\sigma}_z$ one can defined

$$(\sigma_x)_{\alpha\alpha} = \langle\alpha / \hat{\sigma}_x\alpha\rangle = \langle\alpha / \beta\rangle = 0 \quad \dots\dots\dots\dots \quad (15)$$

$$(\sigma_x)_{\alpha\beta} = \langle\alpha / \hat{\sigma}_x\beta\rangle = \langle\alpha / \alpha\rangle = 1, \quad \dots\dots\dots\dots \quad (16)$$

And so on. Alternatively, the matrices may be obtained from equ. (15).

Results

1. Eigenfuctions of protons in orthohydrogen:

The spin quantum number of the two protons in orthohydrogen is S=1, with Ms values 1, 0, -1. Since the spin of two electrons in the molecules is antiparallel, the fields in the Stern-Gerlach magnets, and in the region between them, act only on the magnetic momentums of the protons. The spin state function ψ at t=0(define to be the time when the molecules enter the magnetic field **B** along z axis) is an eigenfunction of S_x with eigen value Ms=1. We need to express it in terms of the eigenfunctions of the Hamiltonian, which are the eigenfunction of S_z.

All spin operators are related to the orbital angular momentum, but the essential feature is that $\ell = 1$, the same value as s here. So the relation between the eiginfunction of the x and z component operators are identical.

If ϕ_1, ϕ_0, ϕ_{-1} are the eigenfunction of S_z, then the eigenfunctions of S_x with eigenvalue Ms=1 is $(\frac{\phi_1 + \sqrt{2}\phi_0 + \phi_{-1}}{2})$, i.e.

$$\psi(0) = (\frac{\phi_1 + \sqrt{2}\phi_0 + \phi_{-1}}{2}).$$

The magnetic momentum of the orthohydrogen molecules is $\mu = 2\mu_{p.}$ So the energies for the states ϕ_1, ϕ_0, ϕ_{-1} in the magnetic field are

$$E_1 = -\mu\textbf{B}, \qquad E_0 = 0, \quad E_{-1} = \mu\textbf{B}$$

Thus

$$\psi(t) = \psi(0).\exp(-i\frac{E_n t}{\hbar})$$

$$\psi(t) = \{\phi_1 \exp(i\omega t) + \sqrt{2}\ \phi_0 + \phi_{-1}\exp(-i\omega t)\}/2 \qquad \ldots\ldots\ldots$$
(17)

Where

$\omega = \frac{\mu\textbf{B}}{\hbar}$ $\ldots\ldots\ldots$ (18)

We now express $\psi(t)$, where t is the time the molecules leave the field **B**, in terms of the eigenfunctions of S_x, i.e. we put

$$\psi(t) = \frac{c_1(\phi_1 + \sqrt{2}\phi_0 + \phi_{-1})}{2} + \frac{c_0(\phi_1 - \phi_{-1})}{\sqrt{2}} + \frac{c_{-1}(\phi_1 - \sqrt{2}\phi_0 + \phi_{-1})}{2} \qquad \ldots\ldots\ldots$$
(19)

The coefficients $|c_1|^2, |c_0|^2, |c_{-1}|^2$ gives the relative numbers of molecules emergencing from the three output channels of the second Stern-Gerlach magnet. The quantities c_1, $c_{0,}$ c_{-1} are obtained by equating the coefficients of ϕ_1, ϕ_0, ϕ_{-1} in equ.(17) and (18).

Thus

$c_1 + c_{-1} + \sqrt{2}c_0 = \exp(i\omega t)$ ………………..… (20)

$c_1 + c_{-1} - \sqrt{2}c_0 = \exp(-i\omega t)$ ……………. (21)

$c_1 - c_{-1} = 1$ … … … … … ….. (22)

Hence

$c_1 = \cos^2(\frac{\omega t}{2}), \; c_{-1} = \sin^2\left(\frac{\omega t}{2}\right), \; c_0 = \frac{i}{\sqrt{2}}\sin(\omega t).$ ……………. (23)

Thus

$|c_1|^2 = \cos^4\left(\frac{\omega t}{2}\right), |c_{-1}|^2 = \sin^4\left(\frac{\omega t}{2}\right), \; |c_0|^2 = 2\sin^2\left(\frac{\omega t}{2}\right).\cos^2\left(\frac{\omega t}{2}\right),$

The quantities $|c_1|^2, \; |c_{-1}|^2, \; |c_0|^2$ are plotted against ωt in Fig. (2).
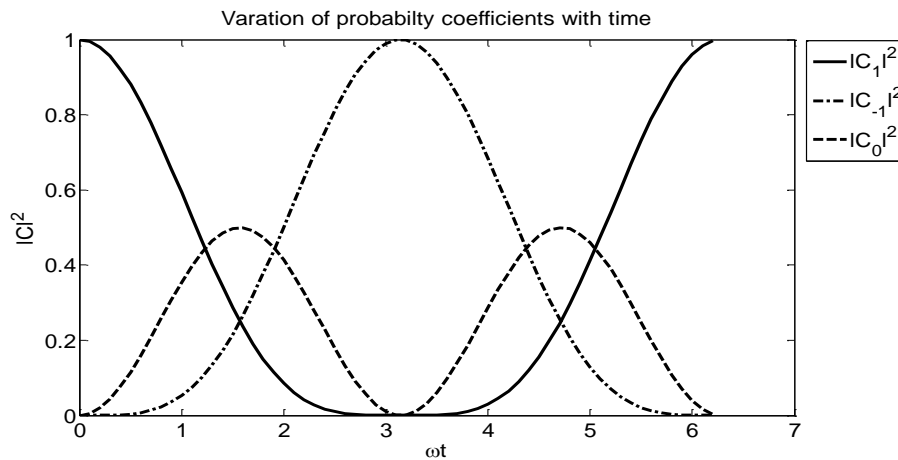
Fig. (2): Variation of probability coefficients with time

Deducing the value of magnetic momentum:

It is clear that from the plot of figure (2) that no molecules emerge from the Ms=1 channel of the second Stern- Gerlach magnet when $|c_1|^2=0$, which, from (23), is when

$$\omega t = (2n + 1)\pi$$

Where n=0, 1, 2,…., From (18) this corresponds to

$\frac{\mu B}{\hbar}t = \frac{2\mu_p B}{\hbar}t = (2n + 1)\pi$

i.e.

$\mu_p = \frac{\pi\hbar}{B_0 t}$

Where

B_0=1.8mT.

If E is the kinetic energy of the molecules, and d the path length in **B,**

$$E = \frac{1}{2}mv^2 = m_p \frac{d^2}{t^2}$$

Since m, the mass of the molecules, is twice the mass of the proton m_p then we get

$$\mu_p = \frac{\pi}{B_0 d}\left(\frac{E}{m_p}\right)^{\frac{1}{2}}$$

Using the values of the variables (d=20mm, $B_0 = 1.8$mT, E=25meV) in the formal formula

μ_p=1.424 × $10^{-26}JT^{-1}$, which is very essential in nuclear calculations.

Discussion:

It is straightforward that the state function $\psi(t)$ is an eigenfunction of the operator S_ρ, the operator for component of spin in the direction $(cos\rho, -sin\rho, 0)$, with eigenvalue Ms=1, where

$$\rho = \frac{\mu}{\hbar}Bt$$

In other words, the quantum mechanical calculation agrees with the classical result that the two protons may be regarded as a gyroscope, which subjected to a couple by the magnetic field. Precesses about the field with the Larmor frequency ω_L=γ**B,** where the gyromagnetic ratio $\gamma = \frac{\mu}{\hbar}$.

The precession is in the opposite sense to that of the neutron, because, for the proton, the magnetic moment and angular momentum vectors are in the same direction. When the spin has precessed through an angle π, the molecules is in the state Ms=-1 (specified relative to the x axis).

We might have guessed that from physical intuition. However, we might also have guessed that, when the spin had processed through $\frac{\pi}{2}$, the molecules would be in the state Ms=0. The quantum mechanical calculation shows this is not so; the state is actually mixture of 50% Ms=0, and 25% each of Ms=±1, and the expectation value $\langle S_x \rangle$ for a $\frac{\pi}{2}$ rotation, is of course zero.

Conclusion:

In conclusion, we have studied a quantum mechanical system comprised of Stern-Gerlach apparatus of two magnets coupled to a constant magnetic field **B**. In quantum regime, we have obtained analytical results for the eigenfunction and magnetic momentum for the proton. Also we show that the analytical investigation of the spin quantum number of moving protons exhibit Lamor frequency, which is related to the gyromagnetic ratio. Our results show that some protons emerge through the second magnet of Sern-Gerlach apparatus for $M_s=1$ and this can be adjusted by controlling the eigenfunction of the particles. These results are useful for the accuracy of nuclear calculations and useful in solid state for investigating the structure of crystals. Possible additional studies include a different oven temperature of particle source and/or a different magnet setting.

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GC- MS Analysis and Antimicrobial Activity of *Curcuma longa* (Zingiberaceae) Oil

Abdelkarim, M*[1,] Fatima, A.[1] and Tohami, E.[2]
   1- Sudan university of science and technology, faculty of science.
   2- University of Bahri,Faculty of Education.

Abstract

Curcuma longa, beside its culinary uses, has a long history in traditional medicine. *Curcuma longa* rhizomes, which contain a yellow pigment, are used as spice and are associated with many pharmacological activities. *Curcuma longa* is disinfectant, antiseptic,analgesic and anti-inflammatory. The plant possesses significant antioxidant capacity and it is a natural remedy for skin irritations, ulcer and cancer. In this study the GC-MS analysis of *Curcuma longa* oil revealed the presence of (45) components constituents. Major constituents of the oil are: Ar-tumerone (45%) and cyclohexane carboxamide, N-Benzyl-N-(2-phenethyl)-(13%).The oil was screened for antimicrobial activity. *Curcuma longa* oil exhibited significant activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa.*

Keywords: *Curcuma longa,* Oil, Constituents, Antimicrobial Activiy.

Introduction:

Curcuma longa (Turmeric) is an evergreen herb in the ginger (Zingiberaceae) family.The plant is widely cultivated in the Asian continent and specially in China and India for its economic and medicinal value.This plant ,beside its culinary uses , has a long history in traditional medicine[1-3].Tumeric rhizomes ,which contain a yellow pigment, are used as spice and are associated with many pharmacological activities.

Tumeric is disinfectant, antiseptic,analgesic and anti-inflammatory.The plant possesses significant antioxidant capacity and it is a natural remedy for skin irritations, ulcer and cancer. Tumeric is also used against arthritis, allergic conditions and Alzheimer,s disease[4]. Tumeric is antimicrobial, antimutagenic and antiparasitic[5,6]. This plant contains flavonoids, alkaloids,protein and some important amino acids[7].

Materials and Methods

Materials:

Plant material:

Curcuma longa L. roots were colledted from a forest reserve around Damazin-Sudan. They were authenticated by direct comparison with reference herbarium samples.

Microorganisms

Microorganisms used for antimicrobial activity are:

-Bacterial strains:

-Bacillus subtilis

-Staphylococcus aureus

-Escherichia coli

-Pseudomonasaeruginosa

-Fungal species:

- Candida albicans

Instruments

- GC-MS (Model: GC-MS-QP2010Ultra).
- Detector: Mass spectrometer.
- Company: Shimadzu.
- Column: Rtx-5MS, length(30m), dimeter(0.25), thikness(0.25µl).
- Carrier gas: Helium.

Methods:

Extracción of the oíl

The plant material(400g) was macerated with n-hexane at room temperature for 72h. Removal of the solvent under reduced pressure gave the oil.

Methylation of the oil

(3ml) of the oil sample was taken in to test tupe. (7 ml) of alcoholic NaOH (prepared by dissolving 2g of NaOH in 100 ml metanol) were added followed by (7ml) alcoholic sulphuric acid.The contents were shaked for about 3 minutes, then left overnight .(2 ml)of supersaturated NaCl was added .(2 ml) of normal hexane were added and then the contents were shaked for three minutes and the hexane layer was collected. (5 µl) taken from the hexane layer were diluted with 5ml diethylether. (1 gm) of sodium sulphate was added as drying agent.Then the solution was flitered and 0.45 µm(I µl) was injected into the GC-MS vial directly

GC-MS analysis

The GC-MS analysis of the extracted oil was recorded on a Shimadzu QP2010 Ultra, the chromatographic conditions are shown below.

Chromatographic conditions

- Column ovan temperatur : 60.0°C.
- Injuction temperatur : 280.0 °C.
- Injuction Mode: Split.
- Flow control mode: linear velocity.
- Pressure: 93.2 KPa.
- Total flow: 50.0ml/min.
- Column flow: 1.5 ml/min.
- Linear velocity: 44.7 cm/sec
- Purge flow: 3.0 ml/min.

Oven temperature program:

- Rate: 10°C/min.
- Temparture from (60→300) °C

Testing for antimicrobial activity

The cup-plate agar diffusion method was adopted, with some minor modifications to assess the antibacterial activity of the extracted oil. One ml of the isolated standardized bacterial stock suspension (10^8-10^9 C.F.U per ml) were thoroughly mixed with 100 ml of sterile molten Mueller-Hinton agar which was maintained at 45°C. Twenty ml aliquots of the inoculated Mueller-Hinton agar were distributed onto sterile Petri dishes. The agar was left to setle, and in each of these plates, two cups (10 mm in diameter) were cut using a sterile cork borer (NO.4) and the agar discs were removed. Alternate cups were filled with 100μL of samples of each of the extracted oil, using standard fine adjustable automatic pipette and allowed to diffuse at room temperature for two hours. The plates were then incubated in the upright position, at 37°C for 18 hours. Two replicates were carried out for the oil against each of the tested organisms. Simultaneously, positive control involving the addition of methanol instead of the extract was included. Upon the completion of incubation, the diameter of the resultant inhibition zones was measured, averaged and the mean values were tabulated.

The same method used above was used to assess the antifungal activity. Sabouraud dextrose agar was used here and the inoculated medium was incubated at 25°C for three days.

Results and Discussion:

GC-MS analysis of *Curcuma longa* oil was conducted and the identification of the constituents was accomplished by retention times and MS fragmentation pattern. A 90-95 % match was observed when comparing the mass spectra with the database on MS library. The typical total ion chromatograms (TIC) is depicted in Fig. (1). Major constituents of the oil are: Ar-tumerone (45%) and cyclohexanecarboxamide, N-Benzyl-N-(2-phenethyl)- (13%).

Table 1: Constituents of *Curcuma longa L.* oil

No.	Name	Ret.Time	Area%
	.alpha.-Phellandrene	5.953	0.13
	3-Carene	6.065	0.03
	o-Cymene	6.349	0.48
	D-Limonene	6.422	0.02
	Eucalyptol	6.488	0.58
	Isoborneol	9.287	0.03
	3-Cyclohexen-1-ol, 4-methyl-1-(1-methylethyl)-, (R)-	9.484	0.04
	.alpha.-Terpineol	9.773	0.07
	Bicyclo[3.1.0]hexan-3-ol, 4-methylene-1-(1-methylethyl)-, acetate	10.025	0.09
	Thymol	12.129	0.60
	2-Pentanone, 4-methyl-4-phenyl-	13.440	0.35
	Caryophyllene	14.179	0.27
	6,10-Dodecadien-1-yn-3-ol, 3,7,11-trimethyl-	14.612	0.21
	.beta.-Bisabolene	14.715	0.04
	1,4,7,-Cycloundecatriene, 1,5,9,9-tetramethyl-, Z,Z,Z-	14.801	0.03
	Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-	15.240	3.39
	1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl-, [S-(R*,S*)]-	15.454	0.28
	cis-.alpha.-Bisabolene	15.687	0.53
	Bergamotol, Z-.alpha.-trans-	15.758	0.10
	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-, [S-(R*,S*)]-	15.968	1.93
	.alpha.-Santalol	16.067	0.27
	7-epi-cis-sesquisabinene hydrate	16.500	0.21
	2,5,9-Trimethylcycloundeca-4,8-dienone	16.579	0.29

	3-[(3-Imidazol-1-yl-propylamino)-methyl]-8a-methyl-5-methylene-decahydro-naphtho[2,3-b]furan-2-one	16.671	0.10
	Curlone	16.891	0.45
	p-Menthane, 2,3-dibromo-8-phenyl-	16.960	2.61
	7-epi-trans-sesquisabinene hydrate	17.124	0.68
	3-Methyl-2-butenoic acid, 2,7-dimethyloct-7-en-5-yn-4-yl ester	17.187	0.25
	Benzene, 1,4-dimethyl-2-(2-methylpropyl)-	17.383	2.62
	cis-sesquisabinene hydrate	17.515	1.17
	Benzene, (1,1,4,6,6-pentamethylheptyl)-	17.740	1.56
	trans-Geranylgeraniol	17.801	0.99
	Pregna-3,5-dien-9-ol-20-one	17.880	1.69
	Dichloroacetic acid, 2,7-dimethyloct-7-en-5-yn-4-yl	18.123	1.27
	Ar-tumerone	18.413	45.55
	Tumerone	18.449	4.64
	Cyclohexanecarboxamide, N-benzyl-N-(2-phenethyl)-	18.967	18.17
	Naphthalene, 1,1'-(1,10-decanediyl)bis[decahydro-	19.620	1.27
	3-Methyl-2-butenoic acid, tridec-2-ynyl ester	19.892	0.47
	Pentadecane, 2-methyl-2-phenyl-	19.964	0.54
	1H-Indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4,7,7-hexamethyl-	20.014	3.57
	2-Propenoic acid, 1,7,7-trimethylbicyclo[2.2.1]hept-2-yl ester, exo-	20.368	0.75
	Spiro[bicyclo[3.3.0]octan-6-one-3-cyclopropane]	20.548	0.47
	1-Isopropenyl-3,3-dimethyl-5-(3-methyl-1-oxo-2-butenyl)cyclopentane	21.264	0.75
	Cyclohexanecarboxylic acid, 3-phenylpropyl ester	21.501	0.46
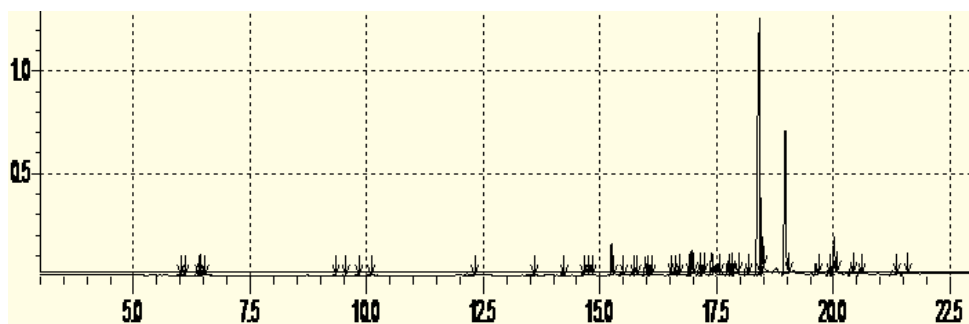
Fig.1: Total ion chromatograms

Table 2: Major constituents of *Curcuma longa L.* roots oil

No.	Name	R.T	Formula	Mw	Area%
1	Ar-tumerone	18.413	$C_{15}H_{20}O$	216	45
2	Cyclohexanecarboxamide, N-benzyl-N-(2-phenethyl)-	18.967	$C_{22}H_{27}NO$	321	13

The IR spectrum of the major components are presented in figures 2 and 3.The molecular ions signals appeared at the expected m/z signals.
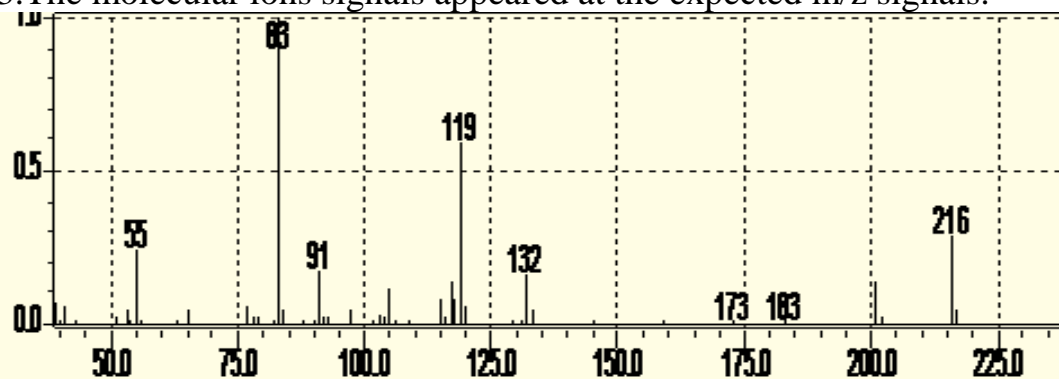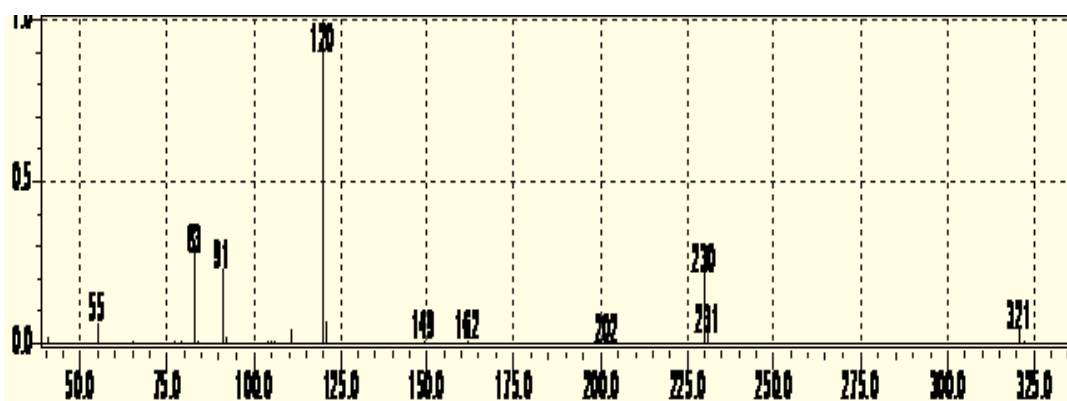

Fig.2 : The mass spectrum of Ar-tumerone

Fig .3: Mass spectrum of cyclohexane carboxamide, N-Benzyl-N-(2-phenethyl)-

Antimicrobial activity

Curcuma longa oil was screened for antimicrobial activity against five standard microorganisms.The results were interpreted as follows. Inhibition zones were interpreted as follows: <9mm, inactive; 9-12, partial activity; 13-18mm active; > 18mm, very active. Ampicilin, gentamycin and clotrimazole were used as positive controls.The studied

oil showed significant activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*(Table 3).

Table 3: Inhibition zones (mm/mg sample)

Type	Sa	Bs	Ec	Pa	Ca
Oil (100mg/ml)	36	--	--	25	--
Ampicilin ((40mg/ml)	30	15	--	--	--
Gentamicin (40mg/ml)	19	25	22	21	--
Clotrimazole (30mg/ml)	--	--	--	--	38

Sa.: *Staphylococcus aureus*; Bs.: *Bacillus subtilis*; Ec.: *Escherichia coli*; Pa.: *Pseudomonas aeruginosa*; Ca.: *Candida albicans*

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Successful Cease-Fire is away to Successful Peace making An Analytical Study On Nuba Mountains Cease-Fire Agreement Birkenstock Switzerland (2022) Sudan.

Dr. Eissa Abaker Mohammed Elhaj

PhD. Peace and Development Studies – University of Juba 2011.
Assistant Professor, Centre for Peace and Development, University of Dalanj.

Abstract:

Recently achieving reliable, successful findings in the field of peace studies has been a difficult task; it depends on good planning and best knowledge of the conflict stages. The gradually progress in reaching solutions gives mediators an opportunity to choose the appropriate stage of conflict and time to intervene achieving conflict resolution. Conflicts in Sudan and in the Nuba Mountains (South Kordofan) have its causes and complications. Achieving an agreement to settle the seventeenth year's war is not an easy job, in the Nuba Mountains Ceasefire Agreement (2002), the parties negotiated and agreed on ceasefire led to the comprehensive peace Agreement (2005). This study, an analytical, evaluated study for the Nuba Mountains Ceasefire Agreement, Switzerland, which considered by number of scholars as one of the very successful ceasefire agreements, it was well organized, supported by the local and international community assist in successful implementation. The study talked the Agreement and analysis its eight Articles, the Articles unbiased and comprehensive. It evaluates the administrative organization monitoring the Ceasefire Agreement and the good cooperation between the warring parties and the local and International community; this led to the Comprehensive Peace Agreement (CPA). Peace and conflict studies researchers may make use of this study.

المستخلص:

أصبح الوصول الى النتائج الموثوقة والناجحة في حقل دراسات السلام حديثاً ليس نشاطاًعشوائياً, بل يعتمد على التخطيط السليم والمعرفة الصحيحة لمراحل النزاع والإنتقال الموضوعي في خطوات الحل لتختار الوساطة المرحلة المناسبة والوقت المناسب للتدخل للوصول الى الهدف

وهو فض النزاع.الصراع في السودان وفي جبال النوبة (جنوب كردفان) له أسبابه وتعقيداته ,الا أن الوصول الى اتفاق يوقف الحرب التي دارت رحاها لما يزيد عن السبع عشرة سنة أمر ليس بالسهل, فالتهدئة التي تمت في جبال النوبة المتمثلة في إتفاقية وقف إطلاق النار (2001– 2005)، تم فيها التفاوض بين طرفي النزاع في السودانة، الحركة الشعبية وحكومة السودان حيث تم الوصول لإتفاق سلام شامل (2005). هذه الدراسة، دراسة تحليلية وتقييمية لإتفاقية وقف إطلاق النار/ جبال النوبة بسويسرا(2001). والتي أعتبرت من قبل المحللين من أنجح إتفاقيات وقف إطلاق النار، من حيث الترتيب الجيد والرغبة الصادقة لأطراف النزاع والمجتمع المحلى والدولى لتحقيق السلام مما ساعد كثيراً في نجاح عملية التطبيق. تناولت الدراسة الظروف التي وقعت فيها الإتفاقية وتحليل مواد الإتفاقية الثمان والتي إتسمت بالموضوعية والحيادية والشمول. وقيمت التنظيم الإداري الذي أشرف على تطبيق الإتفاقية والتعاون الكبير الذى تم بين طرفي النزاع وسكان المنطقة والمنظمات والمجتمع الدولي, الأمر الذى أعطى نتائجاً طيبة قادت الى إتفاقية السلام الشامل في السودان (2005)، يمكن للباحثين الإستفادة منها في دراسات السلام وفض النزاعات.

Introduction:

South Kordofan State located in the west of Sudan, as one of the three States of Kordofan region. Historically the area famous as the Nuba Mountains, that the Nuba tribes anciently inhabited these hills. Other tribes sharing settling the area. The colonial regime considered the region as closed district (the closed district act 1922). This brought so many complications so far.

Although, the people of the region faced: isolation, lack of education, health services, political and social injustice concluded in the term - marginalization.

The Nuba initiated social and political organizations to help their communities, as they feel, they were marginalized and they were suffering much more than others.

In 1948 the Black Rock was borne as an organization represented Negros.

In 1964 The Nuba General Union Party conducted as a political party and won six members to the Sudanese National association.

The Nuba after their awareness, initiated many political organizations, the last one was the Sudanese People's Liberation Movement/Army /Nuba (SPL/M/A) - in 1983.

They occupied considerable territories on land. Many people both male and female joint their military and they fight for long period -1985-2002. The Government of Sudan initiated many opportunities for ceasefire agreement, but the last one of Switzerland-Burgenstock January 2002, which was the initiative of the American special envoy to Sudan Danforth,2001, was the very successful. It was acceptable Agreement, welcomed by the people of the region. It produced the Joint Military Commission (JMC), and the Joint Monitoring Unit (JMU), which were considered as the best pre-peace duration body's yield to Peace negotiation in Sudan.

The Nuba Cease-fire Agreement was the way achieved peace in Sudan 2005. One of its impacts the South Sudan Ceasefire Agreement and the Comprehensive Peace Agreement (CPA) between the Government of Sudan (GoS) and the Sudanese People's Movement /Army (SPL/M/A) in Nairobi 2005, that emerged anew country added to the world, that is South Sudan Country. Here in this study Nuba Mountains means: -

The whole South Kordofan and the province of Lagawa in west Kordofan as it was defined in the Nuba Mountains Cease-Fire Agreement Burgenstock (2002) - Principles of the Agreement.

The problem:

The Nuba people declared their joint to the Sudanese People's Libration (SPLA/SPLM), in 1983. They constructed their own military conveyed from civilian opposition parties to violent conflict parties. Since 1985 they conquered Omdurain village the head quarter of the Moro tribes, the ever biggest tribe of Nuba tribes and who belongs to the strategic locations, including Kouda which had been the headquarter of SPL/A/M/Nuba later.

The Movement was success in persuaded a number of youths, both men and women to joint their military at that time. They send the polarized people to Ethiopia for training as Arm Bush Troops. Since 1985 they returned to the area and began seriously fighting against the government military. They declared that the unfair wealth and power sharing in Sudan is the real motive (incentive) for uprising against the republic of

the Sudan. And declared that they will fight until the problem will be solved. Since then, the area had been under conflict, both sides polarized people to their side, but those who were not with them were be killed, abducted and others taken as prisoners'.

The Nuba Mountains citizens, since then lived under conflict, they witnessed death, lost their cattle, homes, and displaced. They were really under critical problems waiting for solutions. The gate to settle conflict is peace which would start with ceasefire.

Objectives of the Study:

The study trying to high light on circumstances provided the Cease-fire Agreement in the Nuba Mountains at Burgenstock - Switzerland 2002, and evaluates the whole process steps and successful prospect through analysis of international community attitude, the two warring party's positive response and the Cease-fire Agreement Eight Articles to emerge out the causes of the successful implementation.

Danforth's Efforts:

Between so many attempts of mediations between the government of sudan and the Sudanese peoples Liberation Movement the American Special Envoy Danforth succeeded in calling the two warring parties to sit for negotiation. When Jon Danforth, the nearly appointed United States of America Presidential Special Envoy for Sudan, visited the region in October 2001, he unveiled a four-point confidence-building plan. His aim was to test the willingness of the warring parties the Government of the Sudan (Go's) and the Sudan Peoples' Liberation Movement/Army (SPL/M/A), to settle the 18-years conflict.

Danforth's plan was designed to facilitate a ceasefire in the Nuba Mountains, to enable humanitarian aid by temporary cessation of hostilities and to put an end to aerial bombing of civilians and slave raiding.

After years of preliminary talks pressures has increased considerably on both parties to come to a settlement – on Khartoum as a result of supporting Osama Bin Laden in the late 80's and on SPLM/A because its territories were partially sealed from humanitarian aid resulting in wide-spread suffering. The Nuba Mountains truce was effectively both a test case and catalyst for Danforth's ambitious plan.

The prospect for negotiations was helped because the government forces had fought to a stand stilly with the SPL/A entrenched in the hills and the Sudanese armed forces controlling the plains.

Further the areas strategic importance was relatively low, despite its location at the historical North South border and a stride the pipeline caring the oil from the south to Port Sudan.

However due to its central position and its wide variety of ethnic groups of Arab and African origin the Nuba Mountains region considered as the heard of Sudan. This ethnic mix reflects Sudanese society.

Why the Nuba Mountains ceasefire is first in Sudan?

The conflict in Sudan considered as an ever longest conflict in Africa, so the international community regard the end of the war in Sudan is a humanitarian goal that must be achieved.

According to its interests, experiences the United States of America provided a will and provided an advice that achieving a comprehensive peace agreement in Sudan is an appropriate starting to settlement, the beginning from the Nuba mountains because of:

1. The ingredients of the problem are different from those of the South of Sudan, and the problem reliable to be solved.
2. The conflict in the Nuba Mountains at the transformation stage (Improvement).
3. The strong will of the community of the region to stop fighting and achieving peace.
4. The possibility of overpower (domination) of either of the parties was not expected sooner so this brought them to commitment.

Nuba Mountains will be the appropriate access for planning for negotiations to stop Sudanese long conflict in Africa.

Stages of Conflicts:

The proper timing for the mediator to intervene in conflict resolution almost relevant to the stages of the conflict. To give an evident image on the issue in the Nuba Mountains we should discuss the stages of conflict to verify that the American intervene came at the time required. The stages of conflict can be tackled in details according to the researcher school and vision, but the over whole idea is semi alike.

1. No conflict and The Hidden (Latent) Stage:

South Kordofan before the year 1964, the post Sudan Independence era, lived full secured atmosphere. The region was rich with its natural resources. People were living simply, looking after their cattle, managing their farms and enjoying their social competitions. They accepted the poor services produced for them by the governments, hospitals, schools, roads, etc. The society was ruled by simple uncomplicated native administration system. The Native Administration system was constructed by the Turkish and promoted on the English - Egyptian Ruling era. National Governments of Sudan continued ruling by the same system. The Native Administration system got an administrative, judiciary and financial authorities. This system flows its negative shadows later on the local community. Let us brief some of them below:

- Names; in the colonial Acts for the native administration, the Arab Native Administration organized as El-Shiekh, Omda and Nazire. where in the Nuba as El-shiekh, Mekk and Soltan. The Skelton of the Arab Native Administrative system was based on unity and assistance support system, where the Nubian based on unconsolidated tribe's system. These names later differentiate between the people who were of the same society on the same geographic area and under one ruling system.
- The salaries paid for the Arab Native Administration were higher than those paid for the Noba system.
- The Nuba tribe's members admitted to own guns and munitions where the Arabs were not.
- The taxes were paid in the Arab system for cattle and wealth, but in the Nuba system for a man head (dignia). Later to some extent people gained awareness, so many questions came to the surface.

Why the power and wealth sharing of the region on the National level was nil. (Either on the political or the public job). On the other hand, the Arab tribes almost were nomads, while the Nuba tribes were almost farmers, and the relationships between these economical activities looked contradictable emerged to deep unannounced hatred between farmers and pastoralists. All these may consider as general factors constituted the hidden stage in the Nuba Mountains case.

2. **Emergence and Escalation Stage:**

At the democratic era, 1964 – 1968, all the circles for elections represented by central candidates, they won and depart without devoting any attention or services to the people of the region. Such phenomenon added to some awareness in the area guided to conduction of the Nuba Mountains General Union Party, in 1964, which won six seats to the Sudanese National Association. This political Party put on shoulders the issues of marginalization of the region. In 1972 a youth`s organization conducted in Kadugli High Secondary School (Tilo), called Komolo, that was the plant grown to born Sudanese Liberation Movement (SPLM) (1983), and the National Sudanese Party also founded. These political parties composed a case of an organized opposition to the governments through the official State`s Institutions and Organizations. On such environment the mentioned parties began discussing and planning to turn the table from civil political conflict to fight the regime.

3. Conflict Stage:

Komolo was working in high secured system. In 1983 they decided to send number of their members to study the possibility of joining Sudanese Liberation Movement/Army (SPLM/A) commanded by Doctor John Garang. Actually they joint (SPL/M/A) in the same year and declared the starting of a new era, an era of fighting, they declared the Nuba Mountains as an area of violent conflict number two. They attacked Elgardood south Talodi province in 1985, they killed number of civilians. Also attacked El azrag, El-Taiss, Korongo Abdalla and El-Hamra, 1989. They declared Kouda as head quarter for SPL/A/ Nuba. This Stage took the time from 1983 to 2001, the time of the American Special Envoy to the Sudan Danforth`s mediation.

4. The Improvement:-

The two parties were fighting each other since 1985 up to 2001. The international community at that time did so many actions to convince the warring parties to sit for negotiation**s.** The Government of Sudan faced economical complications; political pressure from the internal opposition, this made the Government revised its attitude upon the running war. On the other side the Sudanese Liberation Movement lost most of its territories occupied before and lack of food and services also compelled them to do the same. These circumstances brought the two fighting parties change attitudes and thought about their rights, good will

about the other, this is the stage of improvement, constituting the best moment for the mediator to intervene.

Mediation:

Mediation is a structured, interactive process where an impartial third party assists disputing parties in resolving conflict through the use of specialized communication and negotiation techniques, all participants in mediation are encouraged to actively participate in the process.

A mediator is an acceptable person to warring parties who intervene in an appropriate time to call the parties to sit for settlement and facilitate the negotiations between the parties to the conflict. Hereby, the United States of America played this role in our case the Nuba Mountains Conflict Resolution. The American mediator represented by Danforth, intervene at the appropriate stage of conflict, the improvement stage. His pre-negotiation arrangements were good access for signing the Nuba mountains Cease-fire Agreement (2002) and later the Comprehensive Peace Agreement in Sudan (2005), Nairobi, Kenya.

The Plan for Cease-fire Talks:

Planning recently has been the key for success. The satisfied information available to the mediators gave the map for them to take the right way and stream to settle up conflict in the Nuba Mountains. They draw a good plan to this. The duration of ceasefire for a renewable period of six months. This was a properly period in flexible terms. Each delegation was announced to appoint ten members to the talks, six were took floor on talks; and the other four members assisted them.

 The Governments` delegation included four members from the region, from different positions; and the other six members specialized persons. And the Movements` delegation included three persons from the region and seven specialized.

In December 2001, as a result of United States efforts, the government of Sudan and SPLM agreed in writing that they were "prepared to engage in direct negotiations on the details of the cease-fire, in the Nuba Mountains region, and to meet immediately anywhere in a third country". Since the parties to the conflict could not agree on allocation in Africa the Swiss Government was asked to host negotiations.

Negotiations:

On January 7.2002, an American delegation led by Colonel Dennis Gidens visited burn to prepare the talks and invited Ambassador Joseph Bucher from the Swiss ministry of Foreign Affairs to chair the mediation team due to his long term involvement in Sudanese Affairs – with the inclusion of additional military and legal experts from both countries, the mediation for ceasefire talks became a Swiss – American joint venture.

On January 13th and 14th the two Sudanese delegations headed by commander "Abdalaziz Adam Alhillo (Governor of the SPLM/A region of the Nuba Mountains), and Dr. Mutrif Sidig Ali (Permanent Secretary of the ministry of Foreign Affairs in Khartoum), arrived at Burgenstock in Switzerland to commence the talks.

The Agreement:

On January 19, 2002, after five days of negations, The Government and the SPLM/A signed the Cease-fire Agreement for the Nuba Mountains at Burgunstock.

The main three points of the Agreement were:

- A commitment to end all military fighting in the Nuba Mountains for a duration of six months (this will be renewable with the agreement of the parties);
- The establishment of the international military commission to assist the parties in the implementation of the agreement i.e. a disengagement of their military forces within six months (according to detailed schedules laid down in annex to the agreement).
- The creation of three different zones in the Nuba Mountains (the first exclusively SPLM controlled, the second demilitarized but Government controlled and the third – and by far the largest – zone remaining under government control)

The Agreement consists of eight articles beginning with a preamble of about five paragraphs. Mentioning the agreement reached between the two parties representatives during the meetings which took place in Sudan from the 6th -13th of December 2001, to immediately observed and extend the current military stand - down and to apply it to the Nuba Mountains to facilitate negotiation of the cease-fire and the relief and rehabilitation program;

Reaffirming the will of the parties to negotiate an international monitoring cease-fire agreement to cover the Nuba Mountains,

supervised by a joint military commission (JMC) including third - party participation; and their aware of the vital need to establish a settlement to the conflict which has been taking place for many years and to promote peace in the Nuba Mountains; they having met at the invitation of the Governments of the Swiss Confederation and the United States of America at Burgunstock, Switzerland from 13th - 19th January 2002 to agree on the terms of such cease-fire.

The Articles of the Agreement tackled different issues relevant to the implementation of it, covered both sides necessary for easy successful application.

The Analysis of the Agreement:

The Joint Military Commission (JMC) and the International Monitoring Unit (IMU).

 The Joint Military Commission (JMC) referred to a preamble of the Agreement, that the internationally monitored cease-fire agreement to cover the Nuba Mountains, supervised by a joint military Commission (JMC), including third party participation. Article (VII) detailed on the (JMC) functions. These functions are relevant to the implementation of the Agreement Articles.

A joint Military Commission shall be established to assist in the disengagement and redeployment of the combatants and maintaining the ceasefire in accordance with the terms of this Agreement.p.84

In Article (VII) of the Agreement detailed on the international Monitoring Unit (IMU).

An International Monitoring Unit (IMU) shall be established to assist the parties in implementing this Agreement and maintaining the Ceasefire.

 The (IMU) shall work in collaboration with Joint Military Commission provided for in Article (VII). The two bodies initiated as mentioned in the Articles of the Agreement to assist, share and ease the implementation of the Agreement.

The (JMC) composed of (3) representatives from each party and a neutral Chairman with two Vice – Chairmen.

The Chairman and the two Vice-Chairmen shall be appointed by the participating countries in consultation with the parties. That the total number of (JMC) members should be (9) persons, (6) of them Sudanese Nationalities and three were foreign Nationalities. Where (IMU) consists

of an initial contingent of between 10 and 15 military and civilian personnel provided by countries acceptable to the parties and deployed as monitors in the Nuba Mountains.

The two bodies members were appointed almost by countries accepted to the parties, this is enhanced the conducted body to do its job smoothly, neutrally and build confidential environment for implementation of the Ceasefire Agreement. Also this brought the two warring parties to give their quick serious response for the orientations, request ions and observations provided by the (JMC) and (IMU).

The functions of the (JMC) and (IMU) were complementary. In few cases some functions done by the two parties.

The specific functions of the Joint Military Commission mentioned in Article (VII-2) are:

a. Determining the location of combatants as of the effective date of this Agreement; verifying their disengagement;
b. Monitoring and reporting on the redeployment of combatants from combats positions to defensive positions.
c. Monitoring and reporting on the storage of arm, munitions, and equipment;
d. Supervising the mapping and clearance of mines (this may be done in phases taking in account the requirements of the humanitarian assistance;
e. Inspecting all supplies to both parties;
f. Approving all flights destined to the Nuba Mountains and assure notification to the parties;
g. Coordinating all military movements in the Nuba Mountains;
h. Resolving disputes concerning the implementation of this Agreement including the investigation of any alleged violation;
i. Facilitating liaison between the parties for the purposes of this Agreement.

On the other hand, the mandate of the International Monitoring Unit (IMU) included the following:

- To observe and monitor the cessation of hostilities.
- To monitor the disengagement of forces and their redeployment to defensive positions as stipulated in the Agreement;

- To verify all information, data, and activities of the parties in the Nuba Mountains;
- To assist the parties in creating a favorable operational environment for the conduct of the ceasefire;
- To conduct liaison with humanitarian organizations for the purpose of assisting with relief operations; upon request by any of the parties; to investigate alleged violations of the agreement and to recommend measures to ensure compliance.

Cessation of hostilities and disengagement:

The first step for the process of cease fire is to convey the theme of violation to some extent to a good will to each other. It is beginning with cessation of hostilities, on this side the Agreement mentioning in article IV, the bellow:

1. The parties shall announce a cessation of Hostilities, to be effective within 72 hours after the signing of this agreement that announce of cessation of hostilities shall be disseminated by the parties through command channels, and shall concurrently be communicated to the civil Population via print and electronic media.

2. Until the deployment of international observer, the cessation of hostilities shall be regulated and monitored by the parties through the JMC. Once it has been deployed, the international monitoring unit IMU shall report to the JMC regarding verification control and monitoring of the cessation of hostilities and subsequent disengagement.

3. Once cease-fire has become effective, neither of the Parties shall engage in movement or redeployment of forces resulting in tactical or strategic advantage.

4. Any violation of the cessation of hostilities and subsequent events shall be reported to the JMC through agreed chain of command for investigation.

In fact, the implementation of this article on land was simply applied. The people of the area were received the signing of the agreement with wishes and hopes and real will to progress forward to peace. The term before established of the international observers, JMC and IMU

witnessed commitment from parties, militaries and civilians. At this term no violations recorded but all were committed.

Article V, tackled the process of disengagement of militaries of the two parties. This is a very important after a successful cessation of hostilities. Disengagement enhanced the real will of the warring parties to bring settlement to conflict. In this article of ceasefire (2002) mentioned:

1. Immediate disengagement of all combatants provided in article III, paragraph I, principles of the Agreement, shall be limited to effective range of direct fire weapons. Further withdrawal of weapons so as to place them out of range shall be conducted of the Joint Military Commission.
2. Where immediate disengagement is not possible, as determined by the JMC, a sequence of steps is to be agreed upon by the parties through the JMC.
3. All artillery and indirect fire weapon system within and influencing the Nuba Mountains will be rendered safe in away designated by the JMC.

The disengagement of the combatants, of course is very important step in the cease-fire process, to keep militaries away from each other at appropriate distances, giving the opportunity for both parties and observers to deal with their troops in case there is any indications of violations or incompliance. The next is the movement to defensive positions after disengagement of combatants. Article VI, detailed on the issue of movement to defensive positions:

1. Following disengagement in accordance with the terms of Article V, all combatants shall redeploy from combat positions to defensive positions in accordance with annex B.
2. Upon re-deployment to defensive positions, all combatants shall provide relevant information on troop strength, armaments and weapons they hold in each location to the Joint Military Commission.
3. The JMC shall verify the reported data and information. All combatants shall be restricted to the declared and recorded locations and all movements shall be authorized by the JMC.

All facilities customarily made available to solders, but which cannot be provided at the defensive positions, such as hospitals, logistics units and training facilities, shall be supervised by JMC

Authorities of the (JMC):

In Article (VII-5), the JMC shall be authorized to hire contractors, employ personnel, engage observer and obtain supplies and equipment to assist it in caring out its responsibilities. The parties agree to facilitate the importation of necessary supplies and equipment required for the JMC's activities.

Field of collaboration between JMC, IMU and the parties to the Conflict.

Article Vll.8. gave the parties undertake to provide the

JMC immediately on request with all relevant Information necessary for implementation of this Agreement.

Agreement including the organization, equipment and positions of their forces, on the understanding that such information shall be held in strict confidence.

The parties also under take to accord the JMC and its personnel the facilities, privilege and munities appropriates to its mission.

In article VIII-4 and 6. The IMU shall keep the parties to the Agreement of its observation and monitoring operations.

The size of the IMU may be adjusted with the Agreement of the parties and necessary to carry out the objectives of this Agreement. When we read through details of article (VII) and (VIII) in the Agreement of ceasefire we can conclude the following:

These articles well organized, because of the specific roles each of the JMC and IMU and the parties can play, it evident that the JMC had an executive responsibility than the IMU, the IMU seems as if it was a consultancy or controller body so the Agreement trying to avoid contradictions, this achieved simplicity in the implementation on the ground. It observed also from the articles that there was a big cooperation between the parties concerned, JMC, IMU and the two warring parties. This facilitated the task on the field.

Evaluation and Lessons Learnt from the Nuba Mountains Cease-fire (2002):

Here below the statistic refer to complaints received by JMC awarded ceasefire violations and those responsible. They reflect the developing situation during the JMC`s deployment: in the last two years only few violations were awarded, equally on both sides. When GoS denied access to its Pipeline Units, repeated violations were awarded. Only one of them is included in the statistics, as all of them refer to the same issue (failure to provide information).

1. CFA violations   29%.
2. Not CFA violations   31%.
3. Unsubstantiated   22%.
4. No action taken   13%.
5. Not investigated   5%.
6. Open   0%

Here we provide some selected reports evaluated or persons giving their opinions on the implementation of the Nuba Mountains Ceasefire Agreement. All of them participated on the process somewhere.

Dr. Motrif Sidig, the Undersecretary of the ministry Foreign Affairs Sudan, Leader of the GoS Delegation to the negotiations, wrote:

What has been achieved may provide significant of lessons for future ceasefire and peace initiatives in Sudan, other African countries and elsewhere in the world.

The JMC is unique for four reasons:

Firstly; the JMC is not mandated by the United Nations as are most international peace initiatives.

Secondly; the Nuba Mountains Ceasefire Agreement was initiated in the absence of a comprehensive peace agreement with the primary objective to meet humanitarian needs of the people of the area as well as confidence building measures. Thirdly, the mixed structure of the JMC of unarmed observers and local teams consisting of representatives from each of the Sudanese parties and one international staff member provided impartiality and transparency.

Fourthly; the JMC was supported politically by the friends of the Nuba Mountains which was composed of several diplomats based in Khartoum representing the countries sponsoring the JMC including twelve European countries and the United States of America. This support gave

credibility band leverage to the ceasefire agreement, and eventually to the comprehensive peace process with regards to the entire Sudan.

Commander Abdalaziz Adam Alhilu, SPLM Regional Secretary`s Nuba Mountains (South Kordofan), Leader of SPLM delegation for Nuba Mountains Ceasefire (2002), reported:

Through three years of hard work and commitment, the JMC has paved the way for tranquility after a long history of aggression, settlement after displacement and trust to replace hatred. Not only that, but the JMC has become a leading example to our country and region. It is an incredible achievement in such short time, which would not have been possible if not the quality of both the mission and its personnel.

Bragdier General Jan Erik wilhemsen, Head of Mission JMC, recorded:
By taking on and leading this mission in the Nuba Mountains I had the opportunity to implement in the field 15 years of theoretical and practical experience from several other missions and peaces keeping tasks. Nothing, except for the Ceasefire Agreement, was prepared and that gave me the position to form the mission from the start in line with all the good principles laid in the United Nations Charter and the Strategy, policies and doctrines learned from different peacekeeping missions and training. I was given a free hand and a lot support from all the nations and authorities supporting the mission. For this I am very grateful.

Mission members face two cultures; one inside the mission and one in the Nuba Mountain. In his/her daily work every mission member must learn and respect both cultures to be able to communicate in a National culture, and agenda must be suppressed, and unity of effort along the lines of the idea of the agreement is the key to success.

Relationships and confidence building are the corner stone to achieve the results on the ground. I found it easy to do this from the first day, as the people of sudan are very forthcoming, hospitable, polite and kind.

The people, irrespective of rank and status, have shown a positive attitude to the mission and they want to contribute to solutions and promote the culture of peace and reconciliation.

This is very promising for the future and makes me believe in a permanent and peaceful solution for Sudan with the opportunity for development and a potential to be the good example for the whole region.

Under, Cultural awareness is the key, brigadier General: Hussain Zakaria Ismaail, senior GoS representative of the JMC, Chairman Group, reported:

One key factor for the success of the mission has always been the high cultural awareness. To me it became very obvious in the last three years, that problems can never be solved by force, but only by considerate mental power, it allows us to assist in conflict resolution efficiently, without interfering with the local culture, I hope very much that future peace support operations in Sudan will follow the same principles.

Commander Adam Kuku Kudi, Senior SPLA Representative of the JMC Chairman Group, reported:

I fully concur with all decisions the chairman group has made, we agree on all issues, though sometimes it took some time and diplomatic skills to make a good decision-this is something I really learnt in the Chairman's Group: to discuss things, negotiate solutions and finally find a good compromise acceptable for both sides. So the Chairman's Group experience taught us a lot-on the personal level as well as for the upcoming political decision.

Lisa Schimann from Sweden, Police Monitor, al so reported:

My team includes a GoS police officer and a SPLA police officer, both male. Though our working language is English, they are for more comfortable in Arabic, which I am not-So we have a lot of funny misunderstandings, but in the end we always manage to sort things out, communicating in our language mixture, with body language and sometimes with the help of a translator, if all this leads to now here.

Our main work is to strengthen the local police with advice and support. We monitored ongoing investigations, facilitate the exchange of information, and we try to incorporate our experience if required. We have never been prevented visiting or investigating in village-thanks to Sudanese team members who always find the right words to create an atmosphere of trust. We can move freely between the two areas. Just as it has been agreed upon, and this facilitate our work considerably.

Conclusion:

In this study our first finding is that, the real strong will of the local community, and the fighting parties for peace, with the assistance of the

International community provided the successful Nuba Mountains ceasefire.

The second finding is that, the good planning and preparations for the negotiations by the mediator, and the good appointment of the teams of the two warring parties born successful negotiations.

Third is that, the specifically definition to the problem help parties to jump over obstacles to sign the Nuba Mountains Ceasefire Agreement within five days.

The immediate serious implementation of the Ceasefire Agreement led to the Comprehensive Peace Agreement in Nairobi, 2005.

The long practical experience teaching the people of Sudan how to discuss issues and negotiate with each other's in smart civilized way.

Nuba Mountains region still after separation of the South of Sudan needs extra assistance from the International Community to attain sustainable peace and sustainable socio-economic development.

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Academic Accreditation and its Role in the Development of Academic Programs in Sudan

Prof. **Ahmed Babiker EL-Tahir**
Al-Mughtarbeen University Faculty of Languages
Dr. **Kabashi Omer Saboon Shareef**
University of Dalanj Teachers' College
August 2022

Abstract

 This study tackles the academic accreditation and its role in the development of academic Programs in Sudan. It aims at investigating to what extent the accreditation plays role in developing or improving the actual practices of academic programs. A questionnaire was administered to (77) university professors in (5) colleges of four private institutions of higher education in Sudan. The study shows that (91.3%) of the participants strongly agree that accreditation has a significant role in the development of academic programs. It also reveals that private institutions of higher education endeavor to please the accreditation agencies and satisfy the interest of their candidates by supporting the teaching/learning processes with appropriate learning resources. The study recommends that more studies of this sorts at large scale are needed to include various institutions or to investigate both graduates and stakeholders. It also recommends that accreditation agencies need to monitor closely the accredited institutions and programs to maintain continuous academic performance that meets the accreditation standards. The study also recommends that accreditation agencies need to exercise further pressure on private institutions to provide their staff members with sufficient financial rewards comparable to their counterparts in other countries.
Keywords: accreditation – agencies -private institutions -stakeholders - monitor

المستخلص:

 تتناول هذه الدراسة الاعتماد الأكاديمي ودوره في تطوير البرامج الأكاديمية في السودان. وتهدف إلى التحقق من مدى دور الاعتماد في تطوير أو تحسين الممارسات الفعلية للبرامج

الأكاديمية. تم عمل استبيان لعدد (77) أستاذ جامعي في (5) كليات من أربع مؤسسات خاصة للتعليم العالي في السودان. وأظهرت الدراسة أن (91.3٪) من المشاركين يوافقون بشدة على أن للاعتماد دور كبير في تطوير البرامج الأكاديمية. كما يكشف عن أن مؤسسات التعليم العالي الخاصة تسعى لإرضاء وكالات الاعتماد وإرضاء مصالح مرشحيها من خلال دعم عمليات التدريس / التعلم بموارد تعليمية مناسبة. توصي الدراسة بضرورة إجراء مزيد من الدراسات من هذا النوع على نطاق واسع لتشمل مؤسسات مختلفة أو للتحقيق في كل من الخريجين وأصحاب المصلحة. كما توصي بضرورة قيام وكالات الاعتماد بمراقبة المؤسسات والبرامج المعتمدة عن كثب للحفاظ على الأداء الأكاديمي المستمر الذي يفي بمعايير الإعتماد. وتوصي الدراسة أيضًا بضرورة أن تمارس وكالات الإعتماد مزيدًا من الضغط على المؤسسات الخاصة لتزويد موظفيها بمكافآت مالية كافية مماثلة لنظرائهم في البلدان الأخرى.

Introduction:

The private sector, all over the globe, has come to invest in public education, ranging from kindergartens to colleges and universities. This trend is driven either by pure financial or educational motives, or both. For this reason, governments and civil agencies call for state laws and policies to monitor such institutions and guard the public interest. Sudan is not an exception. The country has witnessed an increase in the establishment of private institutions of high education. This impelled the Ministry of High Education and Scientific Research, hereafter referred to as (The Ministry) to subject private or semi-private institutions to licensure their academic programs to accreditation.

The Ministry represented by the Department of General Administration of Non- Governmental Higher Education has established rigorous standards and criteria to ensure quality of education, guarantee the achievement of high learning outcomes and maintain the public interest.

The paper investigates the accreditation movement in Sudan and its role in the development of (1) Theoretical component of programs. (2) Programs' practical processes. (3) Professional skills and status of faculty. (4) Teaching and learning resources, and programs' learning outcomes in private institutions of higher education. The findings indicate that the accreditation process plays a significance role in the

development and improvement of certain areas of academic programs, but plays a moderate role in other areas.

The private sector plays an important role in the development of any society. It establishes corporations, founds companies, builds factories, and invests in all domains of the society. In recent years, the private sector has indulged public education. Its investment ranged from nursery schools to higher education institutions. This trend is actuated by various motives: financial, educational or both. In other words, there are some private or foreign educational institutions at one end of the spectrum that look for financial gains regardless of the quality of education they provided and invested in.

At the other end, there are others that look for providing quality education regardless of the profit they make. Some other institutions are in between. This makes it incumbent upon the Ministry to subject such institutions to licensure and accreditation.

Licensure and accreditation are two separate but interrelated processes of external evaluation to guarantee quality education and assure the public that licensed institutions and accredited programs are in line with the international standards. Licensure is an official recognition statement given to a specific institution that meets the standards requirements set by the licensing authority, which is the Ministry, whereas accreditation is a status issued to a given program by an accreditation agency or a commission delegated by the Ministry. Licensure has to do with the institution as a whole, but accreditation is specifically assigned to specific programs or an individual program at one particular institution. In this sense, accreditation is a subsequent process to licensure and it is usually sought by the licensed institute itself.
(see Basheer 2002, Teima and Al-Bandari, 2004, Hiiazy et al, 2005 for further information about the two terms).

In some countries, licensure and accreditation are on-going processes. After five years from the initial licensure and accreditation, institution and academic programs have to go through the process of licensure renewal and academic program-re-accreditation. This is done to ensure that licensed institutions and accredited programs continue to adhere to the standards and requirements set by the commission or the Ministry and to prove that the outcomes meet such set standards.

(see 2005, 2007 standards for licensure and accreditation, CAA, Ministry of Higher Education and Scientific Research, U.A.E.).

According to the 2007 standards, "any institution located in the U.A.E. that provides regular, theoretical, practical, or applied curricula of one academic year or longer beyond the U.A.E. secondary school certificate, (or equivalent) and that leads to academic degree, certificate, or diploma, must be licensed and have its programs accredited in order to be officially recognized by the Ministry (2007) Ministry Standards.

The Ministry does not only require private institution to adhere to high standard of quality education and academic performance, but also to show continuous improvement and provide evidence of quality education outcomes.

Despite all the tightened rules and regulations specified by the accreditation commission, the hidden and sometimes public tension between the targeted institute and the accreditation commission is undeniable, even though, in most cases, it is shown in a scholarly manner. Moreover, this could always be a gap between the ideal and the real and between what is needed and is actually done or can be done. In other words, net all that is required by the accreditation commission can always be fulfilled by education institutes. This has been noticed and stated explicitly by (Gildden 1966; Suspistin and Supitsuna 2007).

For this purpose, the current study endeavours to probe into the role of the accreditation process in Sudan, in the actual practice of academic programs at private and semi-private institutions of higher education.

In particular, the study will investigate the role of accreditation in the development and improvement of academic programs in terms of their (a) theoretical components, (b) practical processes, (c) faculty, (d) teaching and learning resources, (e) learning outcomes.

The Conceptual Framework of the Study:

Academic programs are required to go through a meticulous process and painstaking compilation of data necessary that show their merits and characters that make them eligible for the accreditation or re-accreditation whether this process is an indicator of actual development or real improvement in the programs' instructional practices and learning outcomes. The answer to this question represents the main objective of the current study. The researchers follow the conceptual framework

below as a guide to the endeavour of answering this question. The hypothesis is that if the accreditation process has a positive role in the development of academic programs, the participants will rate high in each of the following factors: (1) the theoretical components that refer to the written statements that characterize any given academic program such as its mission, goals, objectives outcomes, curricula, and study plan; (2) the practical processes that refer to all pedagogical practices related to teaching methods and approaches, evaluation, advising, and students' experiences; (3) the professional skills of faculty, that refer to their experiences, qualifications and contribution in other areas of activities; (4) teaching and learning resources, that refer to the available audio-visual aids, library, instrument and other resources that students have access to; (5) learning outcomes, that relate to all that the students were able to achieve from the behavioral objectives, results of tests and exams. The researchers set 70% as the benchmark in the statistical analysis, hence, the role of the accreditation in any of the above factors will be considered significant if that particular factor achieves 70% or more agreement rate among the participants. One might ask why 70%. The benchmark 70% is chosen for two reasons. First, it is used by most programs as a benchmark of the achievement of program learning outcomes; second, it could be an indicator of equality assurance and quality education.

The conceptual framework of the study

(Adapted from, volk-wein et al, 2007)

Significance of the Study:

  Licensure and accreditation practices exist, almost, in all countries that look at education as the most important power of the society. Even justice can't prevail without equality education, let alone annuities and expediencies. However, there is a big difference between making superficial and decorative changes here and there to please the accreditation commission and making substantial changes to meet the established standards and obtain high learning outcomes.

  As far as we know, no systematic research has been done on the impact of accreditation on the actual improvement and development of the higher institutions, private or non-privations. Such research is almost

non-existent in Sudan. Even countries like the U.A.E. that take the practice of accreditation seriously, no systematic research has been done.

Even to the whole region, apart from anecdotal, testimonials from faculty and students and data provided by the academic program for accreditation purposes, such serious systematic research is non-existent. Much of what has been written (Basheer, 2002); (Teimaa and Al-Bandari, 2004); (El-Amine, 2005), Hijazi, et al, 2005) is descriptive account of licensure and accreditation processes, details of the established standards and requirements of accreditation comparison of the accreditation processes in some Arab countries, or a historical account of accreditation. In Sudan a 1st of lip-service is given to quality assurance and quality control but nothing hatches and the result is after a hole in the air.

Despite the rigorous procedure and standards established by the Ministry and implemented by the accreditation commission, there may still be gaps between the theoretical and the actual status of accredited programs and between what is recommended and what is actually done or can be done. Claims continue to be claims unless verified in actual deeds. One way to make sure that claims turn into strategic plans with substantial concrete evidence to ensure the actual effect of licensure and accreditation could be seeking viewpoints of faculty, administration, personal, students' parents, stakeholders, etc. the current study is an endeavour to reach the real and the actual based on the perceptions and beliefs and the people directly involved with academic programs. The study addresses the role of accreditation to the actual development of academic programs from the viewpoints of people directly involved in such programs. The study therefore, constitutes the first step in the right single direction. It investigates what lies on the ground behind all the practices, procedures, and endeavours and pursuits carried out by academic programs to satisfy the accreditation commission.

Objectives of the Study:

This study aims at investigating the extent to which the accreditation processes play a role in developing and improving the conceptual framework of the study.

A comparison between the processes of accreditation in the U.A.E and Sudan may shed light on the actual role of the accreditation process in

developing or improving the actual practices of academic programs. One might ask why the U.A.E and not any other country; the answer is simple, this is because the first researcher happened to be the dean of a faculty that has been subjected to accreditation and re-accreditation and has witnessed the role the two processes have improved or developed the academic programs into ideal programs.

The results of the comparison might stimulate further research and comparisons and draw the awareness of the accreditation commission to areas that need special attention to reach optimal results.

Private Higher Education and Accreditation to U.A.E Private Institution and Accreditation Movement

The Ministry of Higher Education of Scientific Research was founded in 1990 in U.A.E. Prior to that date there were (32) private institutions. They were classified into three categories: six licensed institutions offering higher education, eight non-licensed institutions but offering high education, and eighteen institutions seeking license and not yet offering higher education.

This number has reached fifty-five (55) licensed universities, colleges, and institutes with three hundred and fifteen accredited programs in 2008 as listed to the ministry's official website (http://www.caa.ae/). The need for higher education increases as three number of secondary school graduate's increases, not all secondary school graduates can be admitted into the state institution of higher education to the U.A.E, especially expatriate students. Therefore, the establishment of private institution for higher education becomes a necessity and a logical response to the rapid growth to the country's economy and the rapid increase to the number of secondary graduates to the past few years.

The increase in the number of private institutions of higher education together with the absence of academic standards that guide and monitor the performance of such institution incite some institutions to alienate from their right track of quality education. The government of U.A.E, therefore, established their Ministry of Higher Education and Scientific Research in 1991 as a guarantee of quality education. After the Ministry issued a decree in 1993 revoking all licensure and accreditations prior to that date and required interested institution to reply for new licensure and accreditation. The Ministry, afterwards, formed three commissions for

academic accreditation, CAA, to carry out responsibilities related to licensure and accreditation. Two official documents of "standards for licensure and accreditation" have been separately published in 2005 and 2007 (see the Ministry's official website at (http://www.caa.oa) almost all the leading private institutions of higher education are licensed and the majority of their programs are accredited and listed to the above mentioned website.

 Through licensure and accreditation, the Ministry admits such institutions officially into the legal organization of specific profession. The status of such institutions becomes higher, and their accredited programs acquire the power to award state approved decree (2005 and 2007, ministry standards). Similarly, accredited programs acquire good reputation, power and recognition. Obtaining accreditation has an impact on the ability of the programs to admit students.

 Both licensure and accreditation have become a philosophy and a culture. The first thing students and parents ask about is whether or not an academic program is accredited before they seek admission to it.

  This indicates the public awareness of the significance of licensure and accreditation.

  Accreditation to the U.A.E. is interwoven in the accreditation movement to other parts of the world. There is mutual understanding between the corporation and the CAA in U.A.E and other accreditation agencies via experts' exchanges and mutual interaction between educational institutions to the U.A.E and other leading institutions all over the world. One testimony to this is the recent universal trend among accreditation agencies all over the globe to refocus on their standards and criteria. Accreditation agencies have started to focus on programs effectiveness and measurable learning outcomes as criteria for programs' inputs, learning/teaching processes and human and non-human resources. (see Volkwein et al (2003-2005 and 2007). This trend is clearly reflected to the document at the 2007 standard for licensure and accreditation specified by the CAA at the Ministry of Higher Education and Scientific Research to the U.A.E. (see the ministry's website at http://www.cac.ae) the focus of ten standards defined to the CAA document published to the above website and their interpreting criteria on the effectiveness and accountability of institution and their academic

programs. The assessment processes and their impact on institutional services and academic programs' outcomes are given optimal momentum to the 2007 standards program learning outcomes are looked at as an essential dimension of program effectiveness. This echoes voices that say "students' parents and the public want to know what the learner gained in these academic programs, what it means to them as good citizens and community members".

The CAA requires institutions and programs to conduct self-assessment and prove program effectiveness as a condition for re-accreditation. Programs are also required to show systematic and continuous improvement to all program components (2007 standards). Any academic program has to adopt a clear mission, specific goals, clear and measurable learning outcomes, and scientific measures to document rate how well those outcomes are being achieved. The purpose and **revenance** of accreditation.

The aim of accreditation has been documented by several researchers: (Wiley and Zaid, 1968, Trivet 1976, Seden and Porter, 1977, Basheer, 2002, Teimas and Al-bandari, 2004 and Pokholkou, 2004).

The first and foremost purpose is to ensure the institutions and academic programs have the essential characteristics that needed to achieve a level of excellence in learning outcomes and to ensure that they continue to show improvement.

Through the ten standards of excellence delineated in the 2007 standards and their criteria the CAA to the U.A.E. intends to assure students, their families and stakeholders of the kind of education, students would receive at licensed institutions and accredited programs. Such institutions and their programs acquire broader recognition in the academic community if they are accredited: the students benefit from accreditation in getting better administration services, more effective instructions, and better resources. Moreover, employers and stakeholders are assured that graduates of accredited programs are fully qualified to assume responsibilities. Students also guarantee credit transfer of the course they have studied at an accredited institution and intend to carry to another institution. One of the requirements to all U.A.E. state and private higher education institutions is that only courses taken in accredited institutions can be considered for transfer. Courses that have

been taken at non-accredited colleges and universities cannot be considered.

The impact of accreditation:

In some parts of the world, some students on the impact of accreditation on academic programs have been conducted; (e.g. Peterson and Augustine, 2009, Volkwein et al.2007, Suspitsin and Suspitsyna, 2007). Peterson and Augustine, 2000, for instance, investigated the external influences and institutional dynamics approaches to students' assessment. They found that state influences are minor, the accreditation influences are mixed, and also the report evidence from other research (Ewell, 1993) that the requirements imposed by accreditation authorities only incite the institutional practices and promote assessment initiatives, but the institutional responses are neither rapid (Gill, 1993) nor comprehensive (Geutman and Rogers, 1987). Volkwein et al (2007) traces the impact of changes to the standards of professional accreditation on engineering students' experiences and learning outcomes at 40 different institutions that were reviewed in different years. In Him Wide $ scale study, the researchers collected the data using various sources, students, alumni, faculty, heads of departments and deans of colleges. Contrary to Peterson and Augustina (2000) the findings reveal that engineering programs have changes substantially due to the implementation of new accreditation changes. Engineering programs increase their emphasis on curriculum topics, active learning strategies, professional development activities and assessment activities. Consequently, students are engaged in more interaction with the faculty, and more active involvement in curricular activities, more than those who graduated a decade ago.

Suspitsin and Suspitsyna (2007) probe into the strategies used by Russian private institutions of higher education to cope with the normative state pressures of the accreditation agency. The researchers delineate three different strategies namely: conformity, in which institutions comply with the state legislation and standards, manipulation or backdoor strategies, in which institutions provide the accreditation agency with accurate information in internal programs reviews or use of government connections as an avoidance strategy; and challenges the accreditation agency as strategy of getting away from ability by

established standards (p 67). Suspitsin and Suspitsyna (2007) give a good account of the tension between accreditation agencies and the private educational institutions. In spite of the apparent tension some private institutions of higher education and the accreditation agencies, "state involvement in development of private institution is not only to stay, but is also likely to increase" (Suspitsin and Suspitsyna (2007: p 78).

Research Methodology:

Data Collection

A 36 item closed questionnaire was designed. It was first drafted and then handed to two heads of departments whose programs have been re-accredited and four experts in English language, educational research, measurement and evaluation to ensure face and content validity. The name of a real research has been changed to ensure nepotism or partiality). Based on their useful comments, a final draft in both Arabic and English was created and then distributed. A total number of 1600 copies were distributed to the faculty of eight academic programs of which 77 copies were retained with 88%/ 77.5% return rate.

Items 1-7 investigate the participant perception of the role of accreditation in the development of the theoretical components of academic programs, items 8-11 are related to the role of accreditation in the development of the practical processes of academic programs, items 12- 18 investigate the role of accreditation to the improvement of teaching/learning resources, items 19-30 probe into the role of accreditation in the development of the professional skills and status of faculty, and items 31-36 investigate the role of accreditation to the improvement of program learning outcomes. The researchers use a five-point Likert scale with the following variable: (strongly agree, agree, undecided, disagree and strongly disagree).

Participants:

The participants of the study are one vice chancellor, two deputy vice-chancellors, deans, and heads of departments of staff members to accredited programs in 5 colleges of four private institutions of higher education in Sudan. The population of the study varies between lectures (M.A and MSc holders, assistant professors, associate professors (all Ph.D. holders). The participants also differ in terms of their qualifications, years of experience in higher education, and leadership

positions as shown in table 1 below. They are directly related to the targeted programs and their responses represent hard data since they have firsthand knowledge of what actually goes in such programs.

Table 1. Description of participants

Degree	Masters	doctorate			Total
No	48	29			77
Rank	Lecture	Assistance prof	Associate prof	professor	
No	48	15	10	4	77
	Vice-chancellor	Deputy V.C.	Dean	Heads of departme nt	Staff
Position	2	2	6	12	55 = 77

Limitation of the Study

   This is a small study in terms of scope and participants. It has been conducted in the faculty of the academic programs in 4 private institutions of high education. Thus, the findings could be generalized to all and other accredited programs and institutions. However, the study is a prologue, an indicator, if not an index that would inspire other research activities in other institutions for further findings and conclusions. Still, the findings of the present study have shown that the accreditation process has played a significant role in the development and importance of many facets of academic programs with the ultimate purpose of providing the society with the quality of education it deserves. The study constitutes a building block in the structure of quality education and quality assurance of higher education and to Bakht-Erruda axiom-perfection.

Result and Discussion of the Findings:

The theoretical components: to what extent does the accreditation process play a role in developing and improving theoretical components of academic programs?

Status quo in Sudan:

Accreditation for surgical operation, especially an emergency operation, almost always has severe shock to patient and to his family. Despite modern advances, most people still have an irrational fear of hospitals and aesthetics. People don't often believe they really need surgery, as

opposed to treatment with drugs. However, not every surgeon wants to, or qualified to carry out every type of modern operation in the case with accreditation. The scope of role of the accreditation has changed remarkably in this century. Many developments to accreditation are almost incredible. They include the needed programs.

In Sudan, institutions of higher education fall into three categories: state-institutions; private institutions, foreign and local community (Ahli) institution.

The table below exhibits the awarded specializations in both state and non-state institutions.

No	specialization	Programs				
		Bachelor		Diploma		
		governmental	private	governmental	private	Total
1.	Engineering sciences	94	74	140	30	338
2.	Medical sciences	85	87	24	33	229
3.	Education sciences	165	3	5	-	173
4.	Humanitarian sciences	112	59	35	3	209
5.	Social sciences	93	136	135	93	457
6.	Basic sciences	57	-	34	7	98
7.	Agricultural sciences	94	-	21	1	116
8.	Computer sciences and Information technology	51	67	129	32	279
9.	**Total**	**751**	**426**	**523**	**199**	**1899**

(Taken from a paper presented by prof. Yousif Hasan Abd-alrahman and prof. Abd-alhafiz Altahir Ahmed.

In the coference held by the Ministry of Higher Education
December 2015

Quality assurance of higher education at private institution could be used as a guide for further research.

Results and Discussion of the Findings

The Theoretical Components: to what extent does the accreditation process play a role in developing and improving theoretical components of academic programs?

Seven items (1-7) were designed to collect data related to the role of accreditation in the development of theoretical components of academic programs. Table 2 shows participants' agreement with each of the seven items. The overall average percentage indicates that about 92.3% of the participants agree or strongly agree that accreditation has a role in the development of the theoretical components of academic programs. This

entails that accreditation plays a significant role in the clarity of the mission, the precision, comprehensibility, and measurability of the objectives and outcomes, and comprehensibility and sufficiency of the curriculum.

Table 2: The participants' rating of the role of accreditation in the theoretical components

The accreditation process plays an actual role in developing academic programmers in the following areas	
Agreement rate	
1. All the components of academic programs	97.4%
2. The mission of academic programs	93.5%
3.The clarity, precision, and measurability of program objectives	92.2%
4. The clarity, precision, and measurability of program outcomes	89.6%
5. The study plans (clarity-number of credit courses	94.8%
6. Comprehensiveness of the study plan	88.6%
7. Sufficiency of the curriculum	81.8%
Average percentage	

It is worth nothing that the disagreement rate in the section varies between 1.3% and 7.8% which can be an indicator of almost a common among the participants regarding the significant role of accreditation on program development with a particular reference to this component. The theoretical components of any given academic program legally bind together the institution, its candidates and the accreditation agency as mediator and guarantor. Consequently, accreditation agencies give this part a prime importance. Any program is required to include a detailed statement of the goals and intended outcomes of the new program… (and) demonstrate institution effectiveness by describing improvements made in meeting program goals and outcomes. It shows how those improvements are a consequence of institutional planning and how that planning has used the results of institutional research (2007 standard:33) through an ongoing cyclical framework of planning, practicing, and evaluating heavily focused on the 2007 standards, academic programs ought to show their evaluation of development. Academic programs seem to take much guidance seriously as the findings indicate.

Practical processes: to what extent does the accreditation process play a role in developing and improving the practical processes of academic programs?

Items 8 to 11 were intended to answer this question. Most participants (78.9%) agree or strongly agree that accreditation plays a role in the development of the programs' practical processes such as instructional practices, learning experiences, evaluation of program outcomes, and student advising. The highest disagreement rate does not exceed 11.7% (items 9 and 11) and goes as 2.6% (item 8).

Table 3: The participants' rating of the role of accreditation in the practical processes:

The accreditation process plays an actual role in the development of: Agreement rate	
8. All the teaching/learning processes	85.7%
9. The used teaching methods	74%
10. The evaluation of program outcomes	84.4%
11. Students' academic advising	71.4%
Average percentage	**78.9%**

The 2007 standards give a special attention, instructional practices, and student counseling. It is apparent that the influence of accreditation on teaching and learning processes in its general sense (item 8) receives the highest score (85.7%).

Both the overall average percentage and the percentage of each individual item indicate that accreditation plays a significant role in the development and improvement of programs' practical processes.

Teaching/Learning Resources: to what extent does the accreditation processes play a role in developing and improving learning resources?

It is apparent from table 4 below that the accreditation process has a considerable role in the improvement and development of teaching and learning resources. The overall rate (80.6%) indicates that most participants acknowledge the role of accreditation in improving teaching/learning resources. Labs, library books, journals, classrooms, and technical resources are all important factors in the achievement of program outcomes.

Table 4: The participants' rating of the role of accreditation in the improvement of teaching/learning resources

The accreditation process plays an actual role in: Agreement rate	
12. Improving the teaching/learning resources	89.7%
13. Developing the quality of the library resources	88.4%
14. Adding recent publications to the library	84.4%
15. Providing the library with international journals in your major	78%
16. Connecting the library with other international libraries	70.2%
17. Connecting the library with the worldwide web	71.5%
18. Improving and updating labs	81.9%
Average percentage	**80.6%**

Academic programs need up to date learning resources in order to provide their clienteles with effective learning experiences, based on the participants' responses, it can be concluded that private institutions in higher education endeavour to please the accreditation agency and satisfy the interest of their candidates by supporting the teaching/learning processes with appropriate learning resources. However, there will always be a need for more up to date learning resources. These findings are substantiated by a research done by New England Association of Schools and Colleges (NEASC) in which "75 of the respondents indicated that the accreditation process was important for improving the quality of their resources, including library, multimedia, and technology resources" (NEASC, 2006:11) academic program coordinators use the accreditation or re-accreditation process as a means of additional pressure to press for and justify the funding towards buying more learning resources.

Academic programs are not only required to support the practical processes with the appropriate teaching/learning resources but they also required to evaluate the instructional practices and available learning resources (2007 ministry standards).

The Faculty: to what extent does the accreditation process play a role in developing and improving the professional skills and status of faculty?

Twelve items were designed to collect data related to the participants' perceptions of the role of accreditation in the development and improvement of faculty's professional skills, teaching and non-teaching load, financial rewards, and inclusion in academic decisions. Only about 54.7% of the participants indicate that the accreditation process plays a role in developing and improving the conditions and skills of faculty.

Yet, about 45% of the participants do attest do this perception with over 23% disagree or strongly disagree and about 22% undecided. Item analysis shows that all the items except items 19 and 23 obtain 70% agreement rate as shown in table 5. This agreement rate (45.7%) indicates that the accreditation process plays a less significant role in developing and improving faculty's academic skills, specifying their non-teaching loads, including them in their academic decisions, or improving their financial rewards. Some parts of these findings are substantiated by similar findings in study done by Volkwein et al. (2007) in which about half of the respondents did not any impact of the accreditation on their institution's reward system. Despite all this, the role of the accreditation is evidently significant in specifying the faculty's teaching load (84.5% item 23) and appointing qualified staff members (70.2% item 19).

Table 5: The participant' rating of the role of accreditation in the improvement faculty skills and status

The accreditation process plays an actual role in: Agreement rate	
19. Appointing qualified staff member	70.2%
20. Developing staff members' skills	58.5%
21. Supporting staff members' academic level	59.4%
22. Improving staff members' research role	55.9%
23. Specifying staff members' teaching loads	84.5%
24. Specifying staff members' non-teaching loads	48.1%
25. Raising staff members' salary	48.1%
26. Raising staff members' other allowance	37.7%
27. Improving staff members' teaching performance	53.3%
28. Improving staff members' teaching skills	50.7%
29. Improving staff members' technological skills	57.2%
30. Including staff members' in academic decisions	42.9%
Average percentile	**45.7%**

The 2007 standards look at professional development as an integral part of the development of academic programs. Without the professional development of faculty, program development will not be as successful as it ought to be. The staff members are the turning wheel that pushes program development forwards. Their role in program development is significant and heavily stressed in the 2007 standard.

Therefore, academic programs are required to provide information regarding the effectiveness of faculty development and workload assignment, similar recommendations are found in Volkwein et al. (2007). They point out that academic programs need to show that staff members are engaged in research activities, curriculum revision, self-improvement, and outcomes assessment. They also need to enjoy reasonable academic and non-academic load and get satisfying financial rewards.

Learning Outcomes: To what extent does the accreditation process play a role in ensuring quality learning outcomes of academic programs?

Six items (31-36) were designed to collect data to answer this question. 80.1% of the participants indicate that accreditation plays a major role improving the quality of programs' learning outcomes. Table 6 shows the calculated percentages for each item.

It is worth noting that the public trust in the academic institution (item 36) obtains the highest rate (93.5%). The agreement rates in table 6 show that accreditation plays a significant role in improving, monitoring, and ensuring quality learning quality learning outcomes. The disagreement rate reaches 10.4% (items 31 and 34) and goes as low as 1.3% (item 36). Reliability of learning outcomes (item 34) obtains an agreement rate (66.3%) below the set significant rate (i.e. 70%). The 66.3% indicates that the role of accreditation in the reliability of learning outcomes is less significant. One reason for this low rate could be the vagueness of the item itself.

Table 6: The participants' rating of the role of accreditation in the improvement learning outcomes

The accreditation process plays an actual role in: Agreement rate	
31. Improving learning outcomes	80.5%
32. Monitoring learning outcomes	76.6%
33. Ensuring quality of learning outcomes	76.6%
34. Reliability of learning outcomes	66.3%
35. Increasing the level of public trust in academic programs	87%
36. Increasing the level of public trust in the academic institutions	93.5%
Average percentile	**80.1%**

Improving and achieving high learning outcomes that meet international standards is the optimal objective of academic programs

and accreditation. The task of the accreditation process is to ensure that academic provide the society with individuals capable to excel in the profession they are prepared for. The CAA does not only require academic program to be clear about their goal and outcomes, but also require them to provide "evidence of the ways in which students meet the outcomes of the program and substantiation (italicized in the original source) the way in which other program goals are met… {and prove}. Institution effectiveness by describing improvements made in meeting program goals and outcomes" (2007 ministry standards:30). The findings of this section indicate that the role of accreditation is evident in monitoring, improving, and ensuring quality learning outcomes and increasing the level of public trust both licensed and accredited academic programs.

Recommendations:

Accreditation plays a significant role in the development and improvement of academic programs as the findings of this study show. However, a fact-finding process is an ongoing process. Therefore, to verify such evidence, more studies of this sort, but at large scale that would include varies institutions or investigate both graduates and stakeholders are needed. It is also recommended that accreditation agencies need to continue watching closely the accredited institutions and programs to maintain continuous academic performance that meets the accreditation standards.

More pressure is needed so that private institutions invest more on professional development. They have to organized academic workshops within the institutions or in cooperation with other institutions. They also have to allow, encourage and support staff members to attend local and international conference. More importantly, more workshops are need on accreditation and its importance so that all members of such institutions would be more acquainted with the rewards of such institutions, the staff members, the students and the whole society would gain. Furthermore, the accreditation agencies need to exercise further pressure on private institutions to convince them to provide their staff members with adequate financial rewards comparable or close to close given at foreign, magnetic institutions, in the Gulf or elsewhere.

Conclusion:

Accreditation of higher education (state or private) is an essential practice for more than one reason. Firstly, it guarantees quality education that is paramount in a time like ours where competition becomes very high and job market becomes very selective. Secondly accreditation is a protecting force against any unethical practices directed towards the public or even the faculty. Thirdly, accreditation helps to establish uniformity within the realm of each academia. In other words, the accreditation process, through the establishment of high standards and reinforcement of such standards ought to create homogeny among academic programs to provide the society with individuals with similar competencies that make them eligible to assume responsibilities corresponding to their field of specialization. The findings of the current study show that accreditation process play a significant role in the development and improvement of varies facets of the academic programs. Nonetheless, the degree of this role varies from one fact to another which might require the accreditation agencies to exercise equal pressure to reach desirable outcomes in all program components. In short, the study sheds some light on the strong and weak points of accreditation and hopes to stimulate future research on those facts that might affect quality education. Seeking informational accreditation in the inspiration of all institutions, the ministry of Higher Education is required to collaborate and exchange experience with similar ministries in other countries, particularly the U.A.E. as a pioneer to this field, as witnessed by the researcher himself as a dean and academic advisor to the president of Ajman University.

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Property Spectrum Dissipative Operators in Hilbert and Banach Spaces

Abubaker Abdalla [1] and Adam Dawelbit [2]
(1) Dalanj University, College of Education, Department of Mathematics and Physics, Sudan

wadbabo@gmail.com
(2) Dalanj University, College of Education, Department of Mathematics and Physics, Sudan

Adam Dawelbit Dawelbit@gmail.com

Abstract:
The study talked property spectrum dissipative operators in Hilbert and Banach spaces. The study aims at studying the dissipative operators with spectrum property on Hilbert and Banach Spaces the historical mathematical analytical mathematical analytical method was used. The study showed that the abounded linear operator in Hilbert and Banach spaces interactive he found that the vector space is complementary to Banach Space and that the liner product space is complementary the Hilbert space. The recommended that the research to fine the beach space of all entire function.
Key word: Banach algebra, Hilbert Space, Hermitian operator.

المستخلص:

تناولت الدراسة خصائص طيف المؤثرات التبادلية في فضاءات هلبرت وباناخ. هدفت الدراسة إلى دراسة تبادلية المؤثرات مع خصائص الطيف في فضاءات هلبرت وباناخ . وقد إستخدم المنهج التحليلي الرياضي التاريخي. وأوضحت الدراسة أن المؤثر الخطي المحدود في فضاء هلبرت وباناخ تبادلي. ووجد أن فضاء المتجه مكمل لفضاء باناخ وأن فضاء الضرب الداخلي مكمل لفضاء هلبرت. وقد أوصت الدراسة إلى إيجاد فضاء باناخ في الدوال الكاملة التكامل.

Introduction:

Let X be a complex Banach space and let $B(X)$ be the algebra of all bounded linear operators on X. As usual, $\sigma(T)$ will denote the spectrum of $T \in B(X)$ and $R(z,T) = (zI - T)^{-1}$. The umerical rang$e$ of $T \in B(X)$ is defined by $V(T) = \{\varphi(Tx): x \in X, \varphi \in X^*, \|x\| = \|\varphi\| = \varphi(x) = 1\}$.

The operator $T \in B(X)$ is said to be Hermitian if $V(T)$ is real. Equivalently, T is Hermitian if and only if $\|e^{itT}\| = 1$ for all $t \in \mathbb{R}$ [5, p. 55]. This notion is a natural generalization of bounded selfadjoint operators on Hilbert space and has been of considerable interest in the theory of operators on Banach spaces. Several properties of self-adjoint operators on Hilbert space remain true for Hermitian operators while many others do not, For example, if T is a Hermitian operator, then $\|T\| = r(T)$, where $r(T)$ is the spectral radius of r . This was proved by Browder [7], Katznelson [14] and Sinclair [23]. All the three proofs depend on Bernstein's inequality. More elementary proofs are given by König [16], Bonsall and Duncan [5] and Gorin [12]. In fact, this theorem about Hermitian operators is equivalent to the classical Bernstein's inequality [12,18]. For given $\sigma > 0$, we denote by B_σ the Banach space of all entire functions $f(z)$ for which the norm

$$\|f\|_\sigma = \sup_{z \in C}[exp(-\sigma|Imz|)\,|f(z)|].$$

is finite. The Phragmen–Lindelöf Theorem implies that $\|f\|_\sigma = \sup_{x \in \mathbb{R}}|f(x)|$. It is also known that[12] the differentiation operator $T = \frac{1}{i}\frac{d}{dz}$ is a Hermitian on the space B_σ , and the norm of this operator is equal to its spectral radius if and only if the following classical Bernstein inequality holds:

$$\|f\|_\sigma \leq \sigma\|f\|_\sigma, \; f \in B_\sigma.$$

If we put

$$\sin T = \frac{e^{iT} - e^{-iT}}{2i},$$

then the norm and spectral radius of the operator $\sin T$ $(r(T) \leq \pi/2)$ in the space $B\sigma$ are equal if and only if the following (more delicate) inequality of Bernstein type holds [12]:

$\sup_{x \in \mathbb{R}}|f(x+h) - f(x-h))| \leq 2\sin\sigma h\|f\|_\sigma$ .Where $f \in B_\sigma$ and $0 \leq \sigma h \leq \pi/2$.

Definition(1.1): Vector Space

A vector Space over $\mathbb{C}$ is a set$V$ equipped with two operations:

$$(v, w) \in v x v \qquad \mapsto \qquad v + w \in V,$$
$$(\propto, v) \in \mathbb{C} \, Xv \; \to \propto v \in V.$$

Called addition and scalar multiplication , respectively , that obey the following axioms additive Axioms .There is an element $0 \in V$ and , for each $x \in V$ there is an element $-x \in V$ such that for all $x, y, z, \in V$.We have

(i)$x + y = y + x$.

(ii) $(x + y) + z = x + (y + z)$.

(iii)$o + y = x + o = x$.

(iv) $< -x > + x = x + (-x) = 0$.

Multiplicative Axioms for every $x \in v$ and $\propto, \beta \in \mathbb{C}$.

(v) $0x = 0$.

(vi) $ix = x$.

(vii) $(\alpha\beta) x = \propto (\beta x)$.

Distributive Axioms for every$x, y \in v$ and $\propto, \beta \in \mathbb{C}$.

(Viii) $\propto (x + y) = \propto x + \propto y$.

(iv) $(\propto + \beta)x = \propto x + \beta x$.

Definition(2.1). (inner product):

a- A inner product on a vector space v is a function

$(x, y) \in vxv \mapsto \langle x, y \rangle \in \mathbb{C}$ that obeys.

(i) (linearity in the second argument)

$\langle x, \propto y \rangle = \propto \langle x, y \rangle , \langle x, y + z \rangle = \langle x, y \rangle + \langle x, z \rangle$.

(ii) $(conjugate\ symmetry\ )\langle x, y \rangle = \langle y, z \rangle$.

(iii) $(positive - definiteness)\langle x, x \rangle > 0 \ if x \neq 0$

$for all x, y , z \in V and \propto \in \mathbb{C}$.

b- Two vectors x and y are said to be orthogonal with respect to the inner product $\langle ., . \rangle$ if $\langle x, y \rangle = 0$.

c- Well use the terms "inner product space" or "Hilbert space" to mean a vector space over $\mathbb{C}$ equipped with an inner product.

Definition (3.1) (Banach space):

a- ABanach space is a complete normal vector space.

b- Two Banach space isometric if there exists B_1 and B_2 are said to be amap$U = B_1 \to B_2$ that is .

(i) linear (meaning that $U(\alpha x + \beta y) for all x, y \in B_1$) and $\propto, \beta \in \mathbb{C}$.

(ii) on to (a.k.asurjective)

(iii) Isometric (meaning that $\|U_x\|B_2$ for all $x \in B_1$) this implies that U is $1 - 1$ (a.k.a injective)

Definition (1.4) (Hilbert space):

Let H be aconplet vector space .An inner production H is function , $< ., . > ; HXH \to \mathbb{C}$, such thats.

(1) $< ax + by , Z > = a < x, z > + b < y, z >$ ie : $x \to < x, z >$ is liner.

(2) $< x, y > = < y, x >$

(3)$\|x\|^2 \equiv\, <x,x> \geq 0$ with equality $\|x\|^2 = 0$ iff $x = 0$

(iii)inner product preserving (meaningthat) .

$\langle U_x, U_y \rangle_{H_2} = \langle x,y \rangle_{H_1}$ forallx, $y \in H_1$ such amap is called unitary. Hilbert Space to mean avector Space over $\mathbb{C}$ equipped with an inner product .

Definition. (5.1). a complex commutative Banach algebra:

Let **A** be a complex commutative Banach algebra. The radicalof **A**, denoted by Rad(**A**), is the set of all quasinilpotent elements in **A**. If Rad(**A**) $= \{0\}$, then **A**is said to be semisimple.

If $T \in B(X)$, we let $A(T)$(respectively $W(T)$) denote the closure in the uniform operator topology(respectively in the weak operator topology) of all polynomials in T. Then, $A(T)$ and $W(T)$are commutative unital Banach algebras. It is well known that if $T$is a bounded selfadjoint operatoron a Hilbert space, then $A(T)$is isomorphic to the algebra of all continuous functions on $\sigma(T)$,therefore, $A(T)$ is semisimple. Among the properties that are strikingly different from the corresponding fact for selfadjoint operators is that if $T$is a Hermitian operator, then the algebra $A(T)$needs not be semisimple. To see this let $A(\mathbb{R})$be the Fourier algebra of $\mathbb{R}$ For a closed subset K of $\mathbb{R}$, let $J_k^0 = \{f \in A(\mathbb{R}) : \text{supp}\ f \cap K = 0\}$. As is well known [17, pp. 182, 183], $JK := J_K^0$ is the smallest closed ideal in A($\mathbb{R}$)whose hull is K; $IK = \{f \in A(\mathbb{R}): f(K) = \{0\}\}$is the largestclosed ideal in A($\mathbb{R}$)whose hull is K. $K$is a set of synthesis if and only if $J_k = I_k$. It is afamous theorem of Malliavin that $\mathbb{R}$ contains a compact subset K of non-synthesis. Now, let K be a compact subset of $\mathbb{R}$ and let T be the multiplication operator $f(\lambda) + J_k \rightarrow \lambda f(\lambda) + J_k$on the quotient algebra $A(\mathbb{R})/J_k$. It is easy to verify that $T$is a Hermitianand$\sigma(T) = K$. Moreover, $A(T)$is isomorphic to the algebra $A(\mathbb{R})/J_k$. Since Rad($A(R)/J_k) = I_k/J_k$, the algebra $A(T)$is not semisimple in case Kfails to be of spectral synthesis (see also[24, Corollary 3.4]).A bounded linear operator T on a Hilbert space H is said to be dissipative if Re($T\,x,x) \leq 0$ for all $x \in H$. As is well known, T is dissipative if and only if $\|e^{tT}\| \leq 1\ for\ all\ t \geq 0$. Even on aHilbert space there is no any connection between the norm and the spectral radius of dissipativeoperator. For example, if $V$is the Volterra integration operator on the Hilbert space $L^2[0, 1]$,then the exponential formula [20, Theorem 1.8.3] yields $\|e^{tV}\| =$

1 for all $t \geq 0$. Hence, $-V$ isa dissipative operator. But $r(V) = 0$ and $\|V\| = 2/\pi$[13, Problem 188].An operator $T \in B(X)$is said to be dissipativeif Re $\lambda \leq 0$ for all $\lambda \in V(T)$. Equivalently, T is dissipative if and only if $\|e^{tT}\| \leq 1$ for all $t \geq 0$ [5, p. 55]. Note that if $T$is a dissipative operator,then for every $x \in X$, the limit lim$t \to \infty\|e^{tT} x\|$exists and is equal to inf$t \geq 0 \|e^{tT} x\|$. Note alsothat if $\{e^{tT}: t \geq 0\}$is bounded, then$\||x\|| = sup_{t\geq 0}\|e^{tT} x\|$is an equivalent norm on X with respect T becomes dissipative. Clearly, the spectrum of a dissipative operator $T$is contained inthe closed left half plane. $\sigma(T) \cap iR$is called the unitary spectrumof T. It is trivial to check that$\sigma(T) \subset \{z \in \mathbb{C}: Rez < 0\}$if and only if $lim_{t\to\infty}\|e^{tT}\| \to 0$. In this paper, for the dissipative operator Ton a Banach space, we give quantitative characterizationof $lim_{t\to t}\|e^{tT} T\|$and $limt_{t\to\infty}\|e^{tT} \sin T\|$.These results generalize the above mentionedresults for Hermitian operators.

2.The Hermitian operator on a Banach space

Let T be a Hermitian operator on a Banach space X. Then, the spectrum of T lies on the realline and

$iR(z,T)$

$$= \begin{cases} \int_0^\infty \exp(itz) \exp(-itT)\, dt. & Imz > 0 ; \\ -\int_{-\infty}^0 \exp(itz) \exp(-itT)\, dt, & Imz < 0 \end{cases} \tag{1}$$

[8, Chapter 8, Section 2]. Let $L^1(\mathbb{R})$be the group algebra of R and let

$$\tilde{f}(\lambda) = \int_{-\infty}^{\infty} f(t)e^{-it\lambda}\, dt,$$

be the Fourier transform of $f \in L^1(\mathbb{R})$. Then, we can define

$$\tilde{f}(T) = \int_{-\infty}^{\infty} f(t)e^{-itT} dt .$$

This formula defines a continuous homomorphism from $L^1(\mathbb{R})$into $B(X)$satisfying $\left\|\tilde{f}(T)\right\| \leq \|f\|_1$. In other words, Tadmits $L^1(\mathbb{R})$-calculus. We put $e_n = 2n\chi_n$, where $\chi_n$is the characteristicfunction of the interval $[-1/n, 1/n]$ $(n = 1, 2, \dots)$. It is easy to see that $\tilde{e}_n(T) \to I$in the operator norm topology, as $n \to \infty$. Note also that the operator norm closure of$\{\tilde{f}(T): f \in L^1(\mathbb{R})\}$coincides with $A(T)$. Since $\sigma(T)$lies on the real line, the maximal idealspace of

the algebra $A(T)$can be identified with $\sigma(T)$[17, Chapter 4].In the following proposition we list some basic properties of this calculus (see also [12,16]).

Definition(1.2) : Let T be a Hermitian operator on a Banach space X and let f $\in$ L$^1(\mathbb{R})$. Then, the following assertions hold:

(a) $\sigma(\tilde{f}(T)) = \tilde{f}(\sigma(T))$(the spectral mapping theorem).

(b) If $\tilde{f}(\lambda) = 0$in a neighborhood of $\sigma(T)$, then $\tilde{f}(T) = 0$.

(c) If $\tilde{f}(\lambda) = 1$in a neighborhood of $\sigma(T)$, then $\tilde{f}(T) = I$.

(d) Let g(z) be an analytic function in a complex neighborhood of $\sigma(T)$. If $\tilde{f}(\lambda) = g(\lambda)$in areal neighborhood of $\sigma(T)$, then $\tilde{f}(T) = g(T)$, where g(T)is defined by the Riesz functionalcalculus:

$$g(T) = \frac{1}{2\pi i}\int_\Gamma g(z)R(z,T)\,dz$$

Γ is an appropriate contour around $\sigma(T)$.

Proof.(a) Let Abe the maximal, uniformly closed commutative subalgebra of $B(X)$ containing $T$and I. Let M be the maximal ideal space of A. We denote by $\sigma A(S)$the spectrum of any $S \in A$ with respect to A. Since $A$is a full subalgebra of $B(X)$[6, Section 1], we have

$$\sigma\left(\tilde{f}(T)\right) = \sigma A\left(\tilde{f}(T)\right)\{\Phi(\tilde{f}(T)): \Phi \in M\}$$
$$= \{\tilde{f}(\Phi(T)) : \Phi \in M\} = \tilde{f}(\sigma A(T)) = \tilde{f}(\sigma(T))$$

(b) Let Ube a neighborhood of $\sigma(T)$and let $\tilde{f}(\lambda) = 0$ on U. Since the algebra$L^1(R)$isregular, there exists a function $g \in L^1(R)$such that $\hat{\ }g(\lambda) = 1$ on $\sigma(T)$ and$\tilde{g}(\lambda) = 0$outside U.Then, $\tilde{f}(\lambda)\,\tilde{g}(\lambda) = 0$ for all $\lambda \in R$, which implies $\tilde{f}(T)\tilde{g}(T) = 0$. By $(a),\hat{\ }g(T)$is invertible, sothat $\tilde{f}(T) = 0$.

(c) If $\tilde{f}(\lambda) = 1$ in a neighborhood of $\sigma(T)$, then the Fourier transform of the functions $f * e_n - e_n$ ($n = 1,2,\dots$)vanishes in a neighborhood of $\sigma(T)$. By (b), we have $\tilde{f}(T)\hat{\ }e_n(T) = \hat{\ }e_n(T)$.By letting $n \to \infty$, we find $\tilde{f}(T) = I$.

(d) We may assume that $\sigma(T) \subset (a,b), \tilde{f}(\lambda) = g(\lambda)$on $[a,b], g(z)$is analytic on theregion $D = \{\lambda + iy: a < \lambda < b, |y| < \delta\}$ ($\delta > 0$)and is continuous on its boundary Γ. Let$\Gamma+ = \{\lambda + i\delta: a \leq \lambda \leq b\}$and $\Gamma- = \{\lambda + i\delta: a \leq \lambda \leq b\}$. Choose c,d such that $\sigma(T) \subset (c,d)$and $[c,d] \subset (a,b)$. Then there exists a

function $e \in L1(R)$ such that $\hat{e}(\lambda) = 1$ on $[c, d]$ and $\hat{e}(\lambda) = 0$ outside (a, b). We put $h = f * e$. Since $\tilde{h}(\lambda) = \tilde{f}(\lambda)$ $(= g(\lambda))$ on $[c, d]$, by (b) we have $\tilde{f}(T) = \tilde{h}(T)$. Also since $\text{supp}\tilde{h} \subseteq [a, b]$, using inversion formula

$$h(t) = \frac{1}{2\pi} b \int_a h(\lambda) e^{i\lambda t} \, d\lambda$$

and the identity (2.1) we can write

$$\tilde{h}(T) = \lim_{\varepsilon \to 0^+} \int_{-\infty}^{\infty} e^{-\varepsilon |t|} h(t) e^{-itT} \, dt$$

$$= \frac{1}{2\pi} \lim_{\varepsilon \to 0^+} \int_{-\infty}^{\infty} e^{-\varepsilon |t|} \left(\int_a^b \tilde{h}(\lambda) e^{i\lambda t} \, d\lambda \right) e^{-itT} \, dt$$

$$= \frac{1}{2\pi} \lim_{\varepsilon \to 0^+} \int_a^b h(\lambda) \left(\int_{-\infty}^{\infty} e^{-\varepsilon |t|} \, ei\lambda t \, e^{-itT} \right) d\lambda$$

$$= \frac{i}{2\pi} \lim_{\varepsilon \to 0^+} \int_a^b \tilde{h}(\lambda) \, (R(\lambda + i\varepsilon, T) - R(\lambda - i\varepsilon, T)) \, d\lambda$$

$$= \frac{i}{2\pi} \lim_{\varepsilon \to 0^+} \int_a^c \tilde{h}(\lambda) d\lambda$$

$$+ \frac{i}{2\pi} \lim_{\varepsilon \to 0^+} \int_d^b \tilde{h}(\lambda) \, (R(\lambda + i\varepsilon, T) - R(\lambda - i\varepsilon, T)) d\lambda$$

$$+ \frac{i}{2\pi} \lim_{\varepsilon \to 0^+} \int_c^d g(\lambda) \, (R(\lambda + i\varepsilon, T) - R(\lambda - i\varepsilon, T)) \, d\lambda$$

Note that in the last expression the first two integrals are zero. Therefore, we have

$$\tilde{h}(T) = \frac{-i}{2\pi} \lim_{\varepsilon \to 0^+} \int_\Gamma g(z) R(z + i\varepsilon, T) dz$$

$$- \int_{\Gamma-} g(z) R(z - i\varepsilon, T) dz$$

$$= \frac{1}{2\pi i} \int_\Gamma g(z)R(z,T)\,dz = g(T).$$

Recall that for a closed subset K in R, J_k is the smallest closed ideal in $L^1(R)$, whose hull is K and IK is the largest closed ideal in $L^1(R)$ whose hull is K. We put $IT = \{f \in L^1(R): \tilde{f}(T) = 0\}$. Then, IT is a closed ideal in $L^1(R)$. It follows from Proposition 2.1 that $J\sigma(T) \subset IT \subset I\sigma(T)$ and therefore, $\text{hull}(I_T) = \sigma(T)$. Note also that if $\sigma(T)$ is a set of synthesis, then $\tilde{f}(T) = 0$ if and only if $f(\lambda) = 0$ on $\sigma(T)$. The *Arveson spectrum* [2] of $x \in X$, denoted by $spT(x)$, is defined as the hull of the closed ideal $I_x = \{f \in L^1(R): \hat{}(T)x = 0\}$. Since $I_T \subset I_x$, it follows that $spT(x)$ is a compact subset of $\sigma(T)$. Note also that since $I_T = \cap_{x \in X} I_x$, in view of regularity of $L^1(R)$, we have

$$\sigma(T) = \overline{\bigcup_{x \in X} spT(x)}$$

Lemma(2.2): Let T be a Hermitian operator on a Banach space X, $x \in X$ and $f \in L^1(\mathbb{R})$. Then, the following assertions hold:

(a) If $\tilde{f}(T)x = 0$, then $\tilde{f}(\lambda) = 0$ on $sp_T(x)$.

(b) If $\tilde{f}(\lambda) = 0$ in a neighborhood of spT(x), then $\tilde{f}(T)x = 0$

Proof. The assertion (a) follows from the definition of $sp_T(x)$.

(b) If $\tilde{f}(\lambda) = 0$ in a neighborhood of $sp_T(x)$, then f belongs to the smallest closed ideal in $L^1(R)$ whose hull is $spT(x)$, so that $f \in I_x$. Let M be any non-void subset of $L^\infty(\mathbb{R})$. A point $\lambda \in R$ is said to be a *weak**-spectrum of M if the character $\exp(-i\lambda t)$ belongs to the weak*-closed translation invariant subspace of $L^\infty(R)$, generated by M. By $sp_*\{M\}$, we will denote the set of all weak*-spectrum of M. It is easy to verify that $\qquad sp_*\{M\} = hull(I_{\{M\}})$, where $I_{\{M\}} = \{f \in L^1(R): g * f = 0 \text{ for all } g \in M\}$ is a closed ideal in $L^1(\mathbb{R})$. It follows that $sp_*\{M\}$ is a closed subset of R. Further, since

$$I_{\{M\}} = \bigcap_{g \in M} I\{g\},$$

in view of regularity of $L^1(R)$, we have

$$sp_*\{M\} = \overline{\bigcup_{g \in M} sp_*\{g\}}.$$

Let an arbitrary $g(t) \in L^{\infty}(R)$ be given. The pair of analytic functions

$$G(z) = \begin{cases} \int_0^{\infty} \exp(itz)\, g(t)dt, & \mathrm{Im}\, z > 0; \\ \int_{-\infty}^{0} \exp(itz)\, g(t)dt, & \mathrm{Im}\, z < 0 \end{cases} \qquad (2)$$

is called Carleman transformof $g(t)$. As is known [9, Chapter 11, Theorem 24], $\lambda \in sp_*\{g\}$if and only if there is no analytic extension of $G(z)$into a neighborhood of λ.

Let Tbe a Hermitian operator on a Banach space $X$and let $x \in X$. For an arbitrary $\varphi \in X^*$, define $\varphi x\ (t) = \varphi(exp(-itT\ )x)$. Then, $\varphi_x\ (t)$is a bounded continuous function on R. We put$Mx = \{\varphi x\ (t): \varphi \in X *\}$.

Lemma(3.2): If T is a Hermitian operator on a Banach space X, thenfor every$x \in X$,

$$sp_T\ (x) = sp_*\{M_x\}.$$

Proof. It is enough to show that $I_x = I\{M_x\}$. We see that $f \in I_x$if and only if$\hat{\widetilde{f}}_s(T\ )x = 0$ for all$s \in R$, where $f_s\ (t) = f\ (s - t)$. Now, from the identity

$$\varphi(\tilde{f}s(T\ )x) = \int_{-\infty}^{\infty} f(s-t)\, \varphi\ (exp(-itT\ )x)\ dt$$

$$= \int_{-\infty}^{\infty} f\ (s-t)\varphi_x\ (t)dt = (\varphi_x * f\ )(s), \varphi \in X^*$$

We deduce that $\in I_x \Longleftrightarrow f \in I_{\{Mx\}}$.

Lemma (4.2) : If T is a Hermitian operator on a Banach space X, then for every $x \in X, sp_T\ (x) \subset \sigma T\ (x)$.

Proof. In view of Lemma 2.3 and the identity (2.2), we have

$$sp_T\ (x) = \overline{\bigcup_{\varphi \in X} sp_*\{\phi x\ \}}$$

Therefore, it is enough to show that $sp_*\{\phi x\} \subset \sigma T\ (x)$for every $\varphi \in X^*$. Assume that for some$\varphi \in X^*, \lambda \in sp_*\{\phi x\ \}\ but\ \lambda \in \rho T\ (x)$. Then, there exists a neighborhood $U_{\lambda}$of $\lambda$with

$u(z)$analyticon $U_\lambda$having values in Xsuch that $(zI - T)u(z) = x$ on U_λ. On the other hand, from theidentity (2.1), we have

$$i\varphi\, R(z,T)x = \begin{cases} \displaystyle\int_0^\infty \exp(itz)\varphi_x(t)dt, & \mathrm{Im}z > 0; \\[2em] \displaystyle-\int_\infty^0 \exp(itz)\varphi_x(t)\,dt, & \mathrm{Im}z < 0 \end{cases}$$

This shows that $i\varphi(R(z,T)x)$is the Carleman transform of . Moreover, $i\phi(u(z))$is an analyticfunction on $U_\lambda$and $i\varphi(R(z,T)x) = i\varphi(u(z))$for every $z \in U_\lambda$with $\mathrm{Im}z\_ = 0$. Hence,$i\varphi(R(z,T)x)$can be analytically extended to a neighborhood of λ. This implies that $\lambda /\in \mathrm{sp}_*(\phi x)$.

3.Local spectral properties of Hermitian operators

In this section, we study some local spectral properties of Hermitian operators.

Theorem (1.3): If T is a Hermitian operator on a Banach space X, then for *every $x \in X$,*

$$\|T\,x\| \le rT(x)\|x\|.$$

For the proof, we need some preliminary results. Let $S(\mathbb{R})$denote the set of rapidly decreasing functions on the real line i.e., the set of infinitely differentiable functions $g$on $\mathbb{R}$ such that $\displaystyle\lim_{|x|\to\infty} |x^n g^{(k)}(x)| = 0$ $for\ all\ n,k = 0,1,2,\dots.$

Proof : Let an arbitrary $a > rT(x)$and$\varepsilon > 0$be given. a function $f \in L^1(R)$such that $\tilde{f}(\lambda) = \lambda$on $[-a,a]$and $\|f\|1 \le (1 + a/\varepsilon)^{1/2}a$. From Lemmas 4.2 and 3.2, we deduce that $T\,x = \tilde{f}(T)x$and consequently,

$$\|T\,x\| = \|\tilde{f}(T)x\| \le \|f\|1\|x\| \le (1 + a/\varepsilon)^{1/2}a\|x\|$$

By letting $\varepsilon \to \infty$, we obtain $\|T\,x\| \le a\|x\|$. Since $a > rT(x)$was arbitrary, the theorem is proved.

Theorem (2.3): If T is a Hermitian operator on a Banach space X, then for *every $x \in X\ with$*

$0 \le rT(x) \le \dfrac{\pi}{2}$

$$\|(\sin T)x\| \le (\sin rT(x))\|x\|$$

Proof : Since $= \|\sin T\| \le 1$, we may assume that $rT(x) < \pi/2$. Let an arbitrary$\varepsilon > 0\ and\ a > r_T(x)$be fixed. there exists a function $f \in L^1(R)$such that$\tilde{f}(\lambda) = \sin\lambda\ on\ [-a,a]$ and

$\|f\|1 \leq \left(1 + \frac{a}{\varepsilon}\right)^{\frac{1}{2}}\sin a$. It follows from Lemmas 2.4 and 3.6 that $(sinT)x = \tilde{f}(T)x$. Hence, we have

$$\|(sinT)x\| = \|f(T)x\| \leq \|f\|1\|x\|$$
$$\leq (1 + a/\varepsilon)^{1/2}(\sin a)\|x\|.$$

By letting $\varepsilon \to \infty$, we obtain that $\|(sinT)x\| \leq (\sin a)\|x\|$.

Theorem (3.3): If Tis a dissipative operator on a Banach space X, then for every $x \in X$,

$\lim\limits_{t\to\infty}\|e^{tT}T x\| \leq \sup\{|\lambda|: \lambda \in \sigma_T(x) \cap i\mathbb{R}\}\|x\|$.

Proof: We may assume that $lim_{t\to\infty}\|e^{tT}T x\| > 0$ for some $x \in X$. Let (Y, J, S) be the limitHermitian operator associated to T. Since $i\sigma S(J x) \subset iR$, we have $i\sigma_S(J_x) \subset \sigma_T(x) \cap i\mathbb{R}$ and therefore,

$$r_S(J_x) \leq sup\{|\lambda|: \lambda \in \sigma_T(x) \cap i\mathbb{R}\}$$

we can write

$$\lim\limits_{t\to\infty}\|e^{tT}T x\| = \|SJx\| \leq r_S(J_x)\|Jx\|$$
$$\leq sup\{|\lambda|: \lambda \in \sigma_T(x) \cap i\mathbb{R}\}\|x\|$$

Theorem (4.3): Let T be a dissipative operator on a Banach space X. If $\sigma(T) \cap iR$is at mostcountable, then for every $R \in$ RadW(T)andx $\in$ X,

$$\lim\limits_{t\to\infty}\|e^{tT}Rx\| = 0$$

Proof. Let $\varphi \in X^*$be a unimodular eigenvector of $T*$. It follows from what is showed above that$R^*\varphi = 0$ for every $R \in$ $RadW(T)$. Consequently, $\varphi(Rx) = 0$ for every $x \in X$. Applying ABLVTheorem we obtain as required.

Theorem(5.3): If Tis a cyclic dissipative operator on a Hilbert space H, then for every Volterraoperator V in {T }.

$$\lim\limits_{t\to\infty}\|e^{tT}V\| = 0$$

Proof: First, let us show that $\|e^{tT}Vx\| \to 0$, as $t \to \infty$, for every $x \in H$. We define a new innerproduct in $H$by the formula

$$\langle x, y\rangle = \lim\limits_{t\to\infty}(e^{tT}x, e^{tT}y), \quad x, y \in H$$

(it is easy to see that the limit on the right-hand side exists). This induced a seminorm on H defined by$p(x) = \left(\lim\limits_{t\to\infty}\|e^{tT}x\|^2\right)^{1/2}$

Let $E = kerp$. Clearly, E is a closed hyperinvariant subspace for T .We may assume that $E \neq H$. Let $J : H \to H/E$be the quotient mapping. Then, the inner product $\langle, \rangle$induces an inner product$[,]$on

$K0 = H/E$ by $[Jx, Jy] = \langle x, y \rangle, x, y \in H$. Let K be the completion of $K0$ with respect to the norm generated by this inner product. Then, $J : H \to K$ has dense range and

$$\|Jx\| = \left(\lim_{t \to \infty} \|e^{tT} x\|^2 \right)^{1/2}$$

Now, define an operator $S0$ on $K0$ by $0J = -iJT$. Then, we have

$$\|S_0 Jx\| = \|JT\,x\| = \left(\lim_{t \to \infty} \|e^{(t+s)T}\,x\|^2 \right)^{1/2} \leq \|T\|\| Jx\|, \quad x \in H.$$

Since J has dense range, S_0 can be extended continuously to the whole of K. If we denote this extension by S, then we have $iSJ = JT$ and $\|S\| \leq \|T\|$. Let us see that S is a self-adjoint operator. Since for every $s \in R, e^{isS}J = Je^{sT}$, we have

$$\left\| e^{isS} Jx \right\| = \left(\lim_{t \to \infty} \|e^{(t+s)T} x\|^2 \right)^{1/2} = \|Jx\|.$$

Also, since J has dense range, we obtain $\left\| e^{isS} \right\| = 1$, so that S is a self-ad joint operator. It is easy to see that S is cyclic. Any operator $R \in \{T\}'$ generates an operator $\widetilde{R_0}$ on $K0$ by $\widetilde{R_0}Jx = -iJR$. Since

$$\left\| \widetilde{R_0} Jx \right\| = \|JRx\| = \left(\lim_{t \to \infty} \|e^{tT} Rx\|^2 \right)^{1/2} = \left(\lim_{t \to \infty} \|Re^{tT} x\|^2 \right)^{1/2} \leq \|R\|\|Jx\|$$

and since J has dense range, $\widetilde{R_0}$ can be extended continuously to the whole of K. If we denote this extension by $\tilde{R}$, then we have $i\tilde{R}J = JR$ and $\left\| \tilde{R} \right\| \leq \|R\|$. Moreover, from the identities $\tilde{R}SJ = -i\tilde{R}JT = -JRT = -JTR = -iSJR = S\tilde{R}J$, we deduce that ˆ$R \in \{S\}\_$. Now, let V be a Volterra operator in $\{T\}'$ Since $\sigma(V) = \{0\}$, it follows from the relations $\left\| \widetilde{V^n} \right\| \leq \|V^n\|(n = 1, 2, \dots)$ and from the spectral radius formula that $\sigma(\tilde{V}) = \{0\}$. Also, since S is cyclic self-adjoint operator, $\{S\}' = W(S)$, so that the algebra $\{S\}'$ is semi simple. Thus, we have that $\tilde{V} = 0$. Further, from the identity $\tilde{V}J = JV$, we get $JV = 0$, so that $\|e^{tT} Vx\| \to 0$, as $t \to \infty$, for all $x \in H$. Fix $\varepsilon > 0$. Since the set $\{Vx: x \in H, \|x\| \leq 1\}$ is relatively compact, it has a finite ε-mesh, say $V_{x_1}, \dots, V_{x_n}$, where $\|x_i\| \leq 1 \ (i = 1, \dots, n)$. This clearly implies

$$\|e^{tT}V\| \leq max\{\|e^{tT} Vx_i\|: i = 1, \dots, n\} + \varepsilon$$

for all $t \geq 0$. It follows that $\|e^{tT} V\| \to 0$, as $t \to \infty$

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