CHAPTER ONE

INTRODUCTION

Banana (Musa sp.) is an important fruit crop world wide. Bananas are grown in more than 150 countries, producing 105 million tons of fruit per year. The global production of banana is around 102028.17 thousand tons (FAOSTAT, 2009). Bananas are today grown in every humid tropical region and constitute the 4 largest fruit crop of the world, following the grape, citrus fruits and the apple (Morton, 1987).

Banana is a popular fruit in Sudan and considered one of the most important cash crops. It is well adapted to warm dry weathers and its productivity exceeded 50 tones/ hectare under light fertile soil of the Gash river basin and the Nile River banks of Sudan (FAOSTAT, 2009).

Banana plays a dual role as a food staple in the tropics. It is an important source of food and income to small-scale household all year around. Banana fruits can be eaten fresh or cooked; the trunk and leaves can be fed on livestock and there are other different uses including wrapping food and making ropes and mats (Nelson et. al., 2006; Pillay and Tripathi, 2007). In Sudan, banana ranks first in terms of volume and second after citrus, in terms of value (Bakhiet, 2006).

Banana fruits are popular and it grown along the banks of the Nile and its tributaries. Kassala area considered to be the main producing area of banana in Sudan. Banana main cultivar grown in Sudan is the Dwarf

Cavendish. (Sudan Trade Point, 2015). The common feature of banana production in the Sudan was a mixed farm system and smallholdings of pure stand depending on irrigation from wells and rivers (Bakhiet, 2006). Banana production faced many challenges, one of the most important problems is the losses after harvest. Post harvest diseases and spoilage of the fruits are the most effective problems that affect the shelf life of the banana fruits, world wide and in Sudan as well.

Pesticides are considered indispensable for sustainable agriculture production, in addition to their role in the protection of human health especially in the tropics. (Karan, et.al 2006).

Meanwhile, the increasing and irrational use of synthetic pesticides has become a source of great concern because of their possible effect on human health and non-target components of the environment (Akimbo, and Carvel, 2004). This concern is heightened by the non-specificity and high toxicity of some pesticides and development of resistant strains of microorganisms against other ones. The foregoing has initiated the exploration of safe alternate antimicrobial agents. Accordingly, increasing effects have been primary directed towards minimizing pesticides risks in the environment through ecologically sound innovative measures of diseases control (Guideword, et.al, 1990).

Recently, the uses of natural products for crop protection were greatly emphasized by scientists in everywhere (Guideword, et.al, 1990). Medicinal plants have become the focus of intense study in terms of

validation of their traditional uses, and then it can be used as natural pesticides. These pesticides are generally more selective in their action, economically feasible and less harmful to the environment than synthetic chemicals. (Songhua and Michailides, 2005).

Hence the purpose of this study is to find a way to prolong the shelf life of the banana fruits in Sudan and lessen the hazards of using chemicals.

Objectives:

The aim of this work is to find an alternative to chemicals currently used to prolong the shelf life of the banana plant products.

In this work, we intended to use natural products in treating banana fruits aiming at prolonging their shelf life, using three different concentrations of ethanolic argel leaves extracts (100, 50 and 25%).

CHAPTER TWO

LITERATURE REVIEW

2.1 Banana plant

Banana (Musa sp.) is an important fruit crop world wide. Bananas are grown in more than 150 countries, producing 105 million tons of fruit per year. The global production of banana is around 102028.17 thousand tons (FAOSTAT, 2009). Bananas are today grown in every humid tropical region and constitute the 4 largest fruit crop of the world, following the grape, citrus fruits and the apple (Morton, 1987).

Banana is a popular fruit in Sudan and considered one of the most important cash crops. It is well adapted to warm dry weathers and its productivity exceeded 50 tones/ hectare under light fertile soil of the Gash river basin and the Nile River banks of Sudan (FAOSTAT, 2006).

In some countries, bananas used for cooking may be called plantains, in contrast to dessert bananas. The fruit is variable in size, color and firmness, but is usually elongated and curved, with soft flesh rich in starch covered with a rind which may be green, yellow, red, purple, or brown when ripe. The fruits grow in clusters hanging from the top of the plant. Almost all modern edible parthenocarpic (seedless) bananas come from two wild species – Musa acuminata and M. balbisiana. The scientific names of most cultivated bananas are Musa acuminata, Musa balbisiana, and Musa × paradisiaca for the hybrid Musa acuminata × M. balbisiana, depending on their genomic constitution. The old scientific name Musa sapientum is no longer used. (Morton, 2009).

Musa species are native to tropical Indomalaya and Australia, and are likely to have been first domesticated in Papua New Guinea. They are grown in 135 countries, primarily for their fruit, and to a lesser extent to make fiber and as ornamental plants (ref.).

2.1.1 Scientific classification

Kingdom::Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Family: Musaceae
S.N: Musa sp.

2.1.2 Postharvest Problems

Banana production faced many challenges, one of the most important problems is the losses after harvest. Post harvest diseases and spoilage of the fruits are the most effective problems that affect the shelf life of the banana fruits, world wide and in Sudan as well.

Bananas must be transported over long distances from the tropics to world markets. To obtain maximum shelf life, harvest comes before the fruit is mature. The fruit requires careful handling, rapid transport to ports, cooling, and refrigerated shipping. The goal is to prevent the bananas from producing their natural ripening agent, ethylene. This technology allows storage and transport for 3–4 weeks at 13 °C (55 °F). On arrival, bananas are held at about 17 °C, and then treated with a low concentration of ethylene. After a few days, the fruit begins to ripen and

is distributed for final sale. Unripe bananas can not be held in home refrigerators because they suffer from the cold. Ripe bananas can be held for a few days at home. If bananas are too green, they can be put in a brown paper bag with an apple or tomato overnight to speed up the ripening process (Picq et al, 2000).

2.2 **Argel plant (*Solenostemma argel*)**

Argel (*Solenostemma argel*) is a desert plant of traditional medical uses in the Sudan. It grows wild in the area extending from Dongola to Barber, particularly around Abu Hamad, where it is grown under irrigation (Elkamali and Khalid, 1996). Sudan is regarded as the richest source of this plant (Orange, 1982). Phyto-chemicals of medicinal properties from argel shoots had been reported by many workers (Roos et al., 1980; Kamel et al., 2000; Hamed, 2001). Sulieman et al. (2009) reported that the aqueous extracts of argel have antifungal and antibacterial properties.

The farmers in Kassala State put argel shoots in porous jute sacks in the irrigation canals to be leached by water. The water was effective in controlling aphids and white flies in summer tomatoes and Egyptian bull worm in okra respectively (Unpublished observation). In a pilot field experiment on Brassica nigra, some peripheral plots were severely infested by aphids. The infestation caused stunting of shoots and delayed flowering compared to non-infected plots. However, upon treatment with argel as a soil additive, or a spray of shoot water extract or a combination of soil additive and spray, the vegetative growth was restored in all plots after pest disappearance and the plants flowered within 10-15 days after treatments. The inflorescence was abnormally thick and profusely branched in plants

that received the combined treatment suggesting a growth-regulator-like

effect and indicating the efficiency of argel as a pesticide (Abdelwahab, 2002).

2.3.1. Scientific classification

King dome : Planta

Unranked : Angiospterns

Unraked : Eudicots

Order : Gentianales

Family : Apocynaceae

Sup family : Asclebiadoideae

Genus : Solenostemma

Species : S.argel

2.3.2 Plant distribution

Argel distributes in Arabian Peninsula and North Africa. The bananas, like most other fresh fruits subjected to spoilage and deterioration with very short shelf life.

Practicing proper hygiene and food safety techniques will help prevent food borne illness and prolong the shelf life of these fruits.

The plant Argel (solenostemma Argel) is a member of the family Asclepiadaceae,that comprises and huernia mecrocarpa ,known for their cardiac activity .

Tropical plant that was spread around the tropical world during the colonial days. Widely spread in Egypt chad Algeria, Saudi Arabia(Ahmed, 2004) and northern parts of Sudan. Blew ever, Sudan regarded as the richest source of this plant (organgi, 1982) wild in

northern Sudan extended from Barber to Abu Hamad especially Rub tab area (El-kamalia, 1991).

2-3-3: Medical and pharmacological activity of *S. argel*

In Sudan argel is used traditionally for treatment of colic and gases or treatment of diabetes (Elagid, 2001), Argel have been shown in number of report (Roseate etal,1980) showed the presence of antibiotic substance in ethanol extracts of Argel plant and they also realized the anti-fungal properties of the plant.

Argel is a herb of wide use in Sudanese traditional medicine .phyto chemicals of medicinal properties from argel shoots had been reported by many workers (kamel et al, 2000; Hamed, 2001) .

Antimicrobial properties of argel were reported by Roos et al., (1980), Elhady et al. (1994) and Sulieman et al. (2009). According to Idris et al., (2011), soil application of argel,s dry leaves under the conditions of the Northern State enhanced flowering and yield of adry date cultivar and the influence was attributed to either pesticide or growth promoting ingredients.

CHAPTER THREE

MATERIAL AND METHODS

3-1: The experiment site:

This study is conducted under laboratory condition of Plant Pathology lab., at the College of Agricultural Studies, Sudan University of science and Technology during the period September-October 2017 to investigate the inhibitory effect of argel leaves ethanolic extracts on the shelf life of banana fruits.

This experiment was conducted during the period 18^{th}-25^{th} August-2017.The major objective of this study is to lengthen the shelf age of banana fruits (*Musa SPP*) using extracts of botanical medicinal plant (argel leaves)in Khartoum State(16 41 00 N, 15 7 30 N)Latitude and 31 30 00 E, 34 20 00 E) Longitude.

3-2: Preparation of the Botanical extracts

Argel dry leaves (*S. argel)*, were obtained from local market in Khartoum "Shambat" , Sudan.

200gm of argel leaves were weighed and put in to a conical flask. 100ml of ethanol were then added to the argel leaves. The sample was then transferred rotated using rotary evaporator to reduce the ethanol attached to the sample. Three different concentrations were then prepared using

distilled water, these are: 100%, 50% and 25%.

3-4: Material and equipment's used in the study

Banana fruits, ethanol 95 medical cotton, conical flask, rotary evaporation ,water, sensitive balance.

3.5. The Experiment:

The banana fruits were coated with the different concentrations (100, 50, and 25%) of the ethanolic extracted material. Then the treated fruits were kept in the laboratory with temperature around 25^0C.

The observations was recorded in a daily bases.

3.3. Experimental design:

The experiment was arranged in a Complete Randomized Design.

3.4. Statistical analyses:

The obtained data was statistically analyzed according to analysis of variance (ANOVA) Duncan's Multiple Range Test (DMRT) was used for means separation using Mstat-C statistical package..

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Effect of ginger rhizomes ethanolic extracts on the shelf life of banana fruits

Table (1) shows that no significant difference was recorded within the treatments or when compared with the control in the first two days after treatment.

On the other hand, a significant difference (P=0.05) was recorded within the treatment and when compared to the control. It is obvious that the concentration 25% significantly prolong the shelf life of the banana fruits up to 5 days.

These results is similar to the results obtained by other researchers (ref.).

Table 1. ***The*** effect of ethanolic extract of argel leaves on the shelf life of banana fruits

TREM	DAY1	DAY2	DAY3	DAY4
100	100^{a}	95^{a}	80^{a}	55^{a}
50	100^{a}	95^{a}	71.6^{b}	48.3^{a}
25	100^{a}	86.6^{b}	70^{b}	38.3^{b}
0	100^{a}	80^{b}	51.6^{c}	35^{b}
CV%	0.0	4.2	2.9	9.2
SE±	0.0	3.1	1.6	3.3
$LSD_{0.05}$	0.0	7.1	3.8	7.6
P-Value	0.0	0.003**	0.00**	0.001**

-Means with the same letter in the same column are not significantly different (P= 0.05)

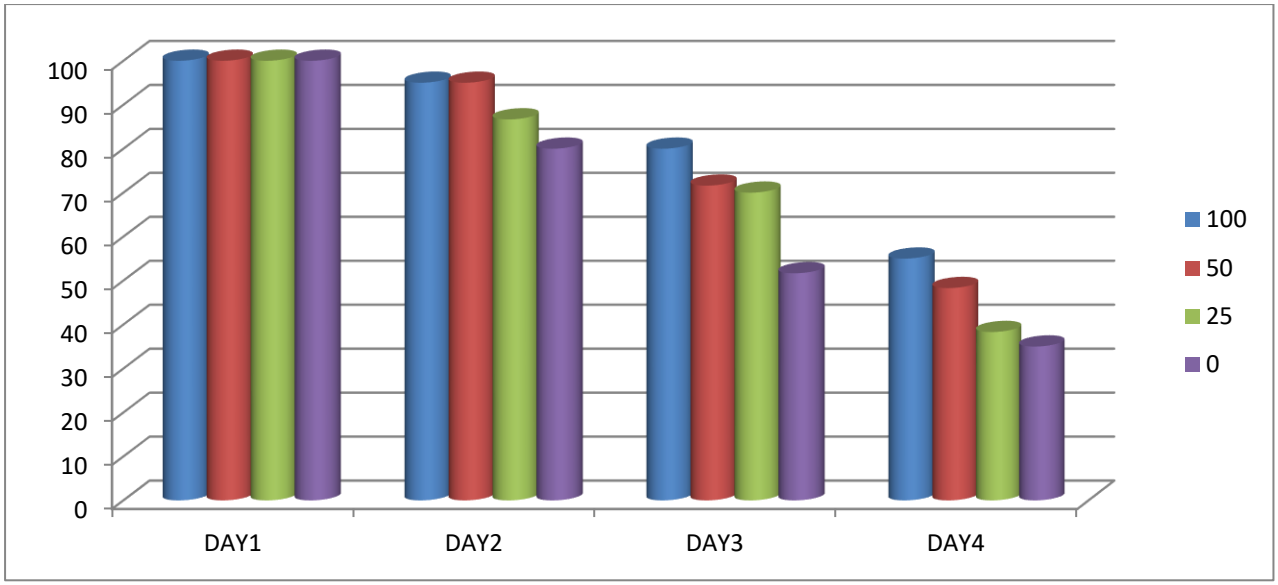

Figure (1): ***The*** effect of ethanolic extracts of argel leaves on the shelf life of banana fruits.

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Appendices

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Descriptive Statistics

	DAY1	DAY2	DAY3	DAY4
N	12	12	12	12
Sum	1200	1070	820	530
Mean	100.00	89.167	68.333	44.167
SD	0.0000	7.3340	10.941	9.0034
Variance	0.0000	53.788	119.70	81.061
SE Mean	0.0000	2.1171	3.1583	2.5990
C.V.	0.0000	8.2251	16.011	20.385
Minimum	100.00	75.000	50.000	30.000
Maximum	100.00	95.000	80.000	60.000

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Completely Randomized AOV for DAY1

Source	DF	SS	MS	F	P
TREM	3	0.00000	0.00000	M	M
Error	8	0.00000	0.00000		
Total	11	0.00000			

Grand Mean 100.00 CV 0.00

WARNING: The total sum of squares is too small to continue.
The dependent variable may be nearly constant.

Completely Randomized AOV for DAY2

Source	DF	SS	MS	F	P
TREM	3	475.000	158.333	10.9	0.0034
Error	8	116.667	14.583		
Total	11	591.667			

Grand Mean 89.167 CV 4.28

At least one group variance is near zero,
variance-equality tests cannot be computed.

Component of variance for between groups 47.9167
Effective cell size 3.0

TREM	Mean
0	80.000
25	86.667
50	95.000
100	95.000

Observations per Mean 3
Standard Error of a Mean 2.2048
Std Error (Diff of 2 Means) 3.1180

Completely Randomized AOV for DAY3

Source	DF	SS	MS	F	P
TREM	3	1283.33	427.778	103	0.0000
Error	8	33.33	4.167		
Total	11	1316.67			

Grand Mean 68.333 CV 2.99

At least one group variance is near zero,
variance-equality tests cannot be computed.

Component of variance for between groups 141.204
Effective cell size 3.0

TREM	Mean
0	51.667
25	70.000
50	71.667
100	80.000

Observations per Mean 3
Standard Error of a Mean 1.1785
Std Error (Diff of 2 Means) 1.6667

Completely Randomized AOV for DAY4

Source	DF	SS	MS	F	P
TREM	3	758.333	252.778	15.2	0.0012
Error	8	133.333	16.667		
Total	11	891.667			

Grand Mean 44.167 CV 9.24

	Chi-Sq	DF	P
Bartlett's Test of Equal Variances	0.95	3	0.8128
Cochran's Q	0.3750		
Largest Var / Smallest Var	3.0000		

Component of variance for between groups 78.7037
Effective cell size 3.0

TREM	Mean
0	35.000
25	38.333

```
  50  48.333
 100  55.000
Observations per Mean            3
Standard Error of a Mean    2.3570
Std Error (Diff of 2 Means) 3.3333
```

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LSD All-Pairwise Comparisons Test of DAY2 by TREM

TREM	Mean	Homogeneous Groups
50	95.000	A
100	95.000	A
25	86.667	B
0	80.000	B

```
Alpha              0.05     Standard Error for Comparison  3.1180
Critical T Value  2.306     Critical Value for Comparison  7.1902
There are 2 groups (A and B) in which the means
are not significantly different from one another.
```

LSD All-Pairwise Comparisons Test of DAY3 by TREM

TREM	Mean	Homogeneous Groups
100	80.000	A
50	71.667	B

```
  25  70.000   B
   0  51.667    C

Alpha              0.05     Standard Error for Comparison  1.6667
Critical T Value  2.306     Critical Value for Comparison  3.8433
There are 3 groups (A, B, etc.) in which the means
are not significantly different from one another.
```

LSD All-Pairwise Comparisons Test of DAY4 by TREM

TREM	Mean	Homogeneous Groups
100	55.000	A
50	48.333	A
25	38.333	B
0	35.000	B

```
Alpha              0.05     Standard Error for Comparison  3.3333
Critical T Value  2.306     Critical Value for Comparison  7.6867
There are 2 groups (A and B) in which the means
are not significantly different from one another.d
```