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EFFECT OF SOME MEDICINAL AND AROMATIC PLANTS EXTRACTS ON STORABILITY OF POTATO AT THE AMBIENT TEMPERATURE: 1- SPROUTING BEHAVIOR, WEIGHT LOSS AND DAMAGE PERCENTAGE.

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ABSTRACT

Storage experiment of summer potatoes was carried out at Fac. of Agriculture laboratories, El-Mansoura University during the two successive seasons of 2013 and 2014, to investigate the effect of some extracts of medicinal and aromatic plants as organic inhibitors of potato (Spunta cv.) on sprouting behavior, weight loss and damage % at the ambient temperature for 6 months period. The different organic inhibitors were extracted from the different aromatic and medicinal plants (Lemon balm, Sage, Nees, Nerium, Salix and Neem plants) as powder and aqueous extracts.

Results indicated that, the lowest sprouting%, weight loss and damage % obtained by cold storage and lemon balm (powder, aqueous extract and powder plus aqueous extract) followed by the sage and nees treatments as compared with the other treatments. Also, the results showed that the highest sprouts number were obtained from control and neem aqueous extracts. Generally, the present study recommended that:

- The best sprouting % and lower of fresh loss rat and the best quality of tubers which treated with Lemon balm followed by Sage and Nees at the ambient temperature.
- The storage tubers of potato with extracts of medicinal and aromatic plants as alternative method instead of cold storage and Nawalla storage for consumption and processing.
- Also, treating stored potatoes with more natural sources of these medicinal and aromatic extracts may represent an alternative approach to managing sprouting and disease in storage. Natural products are available in local grocery. Ideally these natural compounds would be inexpensive, easy and safe to use, and would have no negative impact on flavor or quality of the potato.

Finally, must be done future studies on the rest of the extracts of medicinal and aromatic plants in the hope of finding one or more of medicinal and aromatic extracts effective in reducing the rate of sprouting. Consequently, could mix suitable for non-sprouting and increase the efficiency of storage tubers.

Keywords*:* Potatoes, storability, sprouting, organic inhibitors, powder or ground of medicinal and ornamental plants, medical and aromatic plants extracts, Lemon balm, Sage, Nees, Nerium, Salix and Neem plants.

INTRODUCTION

Potatoes (*Solanum tuberosum* L.) is an essential food crop all over the world and was the first non-grain food product. With nearly 36, 5 million ton harvested in 2010, it ranks fourth in world production after rice, wheat and maize (FAO STAT, 2012). In Egypt it has been generally cultivated for both local consumption and export, acreage planted with potatoes was 421, 876 feddans with an average yield of 11.28 ton/fed. According to statistical data of Ministry of Agriculture (2012).

The length of tuber dormancy depends on both the genotype and environmental conditions during growth and storage. In many potato cultivars, natural dormancy progression occurs over a period of many months. Tuber formation under cool and wet conditions may extend the dormant period, whereas hot and dry conditions typically shorten dormancy (Burton, 1989 and Hasan, 1999). Also between 3°C and 25°C, tuber dormancy duration is inversely related to post-harvest storage temperature, but storage temperatures below 3°C or above 30°C are stressful and result in premature sprouting (Wurr and Allen, 1976).

The major problems that occur during potato storage are sprouting, weight loss and rotting in Nawalla. On the other hand, cool storage conditions can reduce metabolic activity, respiration rates, and aging in tubers, therefore prolonging natural dormancy. Under low storage temperature, starch is converted to sucrose. Accumulation of reducing sugars is a particular concern for potatoes produced for fresh market and for the processing industry as it causes a browning and a bitter taste (Bredameijer *et al*. 1991; Pritchard and Adam, 1994; Hartmans *et al.,* 1995; Hertog *et al*. 1997; Kaaber *et al*., 2001 and Sharma, 2012).

The history of using volatile essential oil components in the inhibition of sprouting goes back many centuries. For generations, the Incas of South America have buried their potatoes in pits covered with soil and the leaves of muña (*Minthostachys glabrescens*) plants. Muña plant is a member of the mint (Lamiaceae) family (Aliaga and Feldheim, 1984). The plant contains an essential oil that very effectively inhibits sprouting in potatoes (Vaughn and Spencer, 1993).

However, carefully controlled cold temperature storage is not an option for typical small-scale or backyard growers. Commercial growers of table and processing potatoes have the option to use chemicals such as CIPC (Chlorpropham) to control sprout growth during storage, but this option is again not available to seed or small scale growers. Consequently, most tubers are stored at 4-5°C for seed, at 7-10°C for fresh market and at 10-15°C for processing (Western Potato Council, 2003). Sprouting causes increased weight loss, reduced tuber quality and impedes air movement through the potato pile. Sprouting also, causes softening, and is associated with the conversion of starch to sugar, which is undesirable for the processing industry. In addition, major causes of decay during storage are microbial diseases and shrinkage because of moisture loss, which make tuber unmarketable.

In the last time, some organic inhibitors used and proved efficient sprout suppressive and anti- microbial actions (Eboel- Seoud *et al*., 2010; El-Awady *et al.* , 2011 and 2014; El-Bashir *et al*., 2011; Ogundajo *et al*., 2011; Teye *et al*. 2011; Sharma, 2012; Tartoura *et al.* 2012 b; Khalid *et al*., 2013; Sharaby *et al*., 2014 ab and Tortoe *et al.,* 2015). The mode of action is physically damage the developing sprout, which the shrivels and becomes desiccated (Coleman *et al*., 2001; Bayder and Karqdogan, 2003 and Tartoura *et al.,* 2012 b).

Elsadr and Waterer (2005) studied the efficacy of natural compounds to suppress sprouting in potato tubers. The following treatments were used T_1- ground dill leaves mixed evenly with potatoes,T_2- carvon on filter paper above potatoes,T_3-ground cloves mixed evenly with potatoes,T_4- clove oil, T_5- garlic powder,T_6- di-allyl disulfied saturated on filter paper above potatoes,T_7- ground peppermint leaves,T_8-peppermint oil,T_9- ground peppermint leaves placed in a Petri dish set on top of the potatoes and T_{10} – control. They found that after 14 and 28 days after treatments the control had the greatest sprout development when compared to the lowest sprouting % obtained by the garlic powder applied at a concentration of (1g/6 tubers), peppermint oil (1ml/6 tubers) ground cloves treatments. Fathy *et al.* (2005) studied the effect of natural essential oils by fumigation and marjoram extract at concentration of 0, 10, 20 and 30 ml /l by dipping method for inhibiting sprouting of potato tuber, stored at ambient temperature for 5 months period in comparison with cold storage (4 and 10 ^{0}C). They found that all the fumigated essential oils and marjoram extract at different concentrations greatly suppressed the incidence of sprouting and the incidence of sprouting fresh weight loss and damage compared with control. Also they found, that fennel oil (6ml /20 kg tubers) and marjoram(20 ml / l) were as effective as cold storage (4 and 10 ^{0}C), in suppressing. Okigbo and Nmeka (2005) used leaf extracts of *Xylopia aethiopica* and *Zingiber officinal* to control tuber rot under storage conditions. They found that the lowest percentage decay observed in tuber treated with Zingiber extracts compared to other treatments and control. Bulus *et al.* (2006) evaluated the efficacy of some plant extracts on the control of potato tuber soft rot. They found that neem leaf and seed aqueous extracts significantly reduced the incidence and severity of tubers soft rot under room storage conditions. Amienyo and Ataga (2007) found that using plant extracts of *Zingiber officialis, Annona muricata, Gacinia cola* and *Allium sativum* significant reduction rot development of *Aspergillus flavus, Aspergillus niger* and *Fusarium oxysporum* on sweet potato tubers under storage conditions.

Sanli *et al*. (2010) investigated the effects of different caraway seed treatment (ground and whole seed and doses (50,100 and 150g) compared with the control and chlorpropham (CIPC) on sprouting, sprout length, the number of sprouts per potato tuber under two different temperatures (8 ^{0}C and 15 ^{0}C). They found that ground caraway seed at 150g was the most effective treatment for preventing weight loss when stored at 15 ^{0}C compared to control. Whole and ground seed treatments were more effective in reducing weight losses of tubers at 8 ^{0}C than they were at 15 ^{0}C. The lowest number of sprouts per tuber was observed for ground seed and (CIPC) treatments. Amoah *et al*. (2011) declared that low sprouting in stored tubers

were desirable however, sprouting might also be an indication of potency of a plant extracts ability to inhibit sprouting of the tubers. Teye *et al.* (2011) studied the effect of per-storage treatments (Ash, Brine, *Lantana camara* extract and control) in sweet potato stored at temperature and relative humidity of 25 ^{0}Cand 90%, respectively. They found that sweet potato treated with the *lantana camara* extract or ash treatment were most effective in reducing sprouting and may be explored to extend the shelf- life as compared to the other treatments.

Recently, Bhardwai (2012) found that seed extracts of *Dedonia viscosa* combined with leaf extracts of *Acocia cotechi* inhibited growth of the pathogenic organism in potato. Ghassan *et al*. (2012) studied the different concentration (500 and 5000 ppm) of 5 ethanol extracts of neem, pong-pong, chili, lemon grass, and ginger compared with fungicide (Guazatine, 1000 ppm) for their anti-fungal activity in vitro and during storage conditions. They found that pong-pong, neem, and chili showed positive effects on the inhibition of post-harvest fungi as alternatives to fungicides.

Bibah (2014) studied the effect of aqueous extract of onion bulb, ginger and neem seed 5% (w/v) on sprouting percentage of sweet potato at room storage conditions (28.9$\pm$4.0 ^{0}Cand 44.6-18.4% RH) for period of two months. They found that sweet potato tubers treated with neem extract recorded the lowest sprouting%, tuber weight loss and decay percentage when compared to other treatments. Also, they found that treated sweet potato tubers with neem or ginger extracts increased tuber firmness and total soluble solids (TSS) compared to untreated tubers. Sharaby *et al.* (2014 a) recorded that dusting potato tuber with bulb powder of *Allium cepa*, *Pelargonium graveolens* and *Cymbopogon citratus* oils caused high reduction is larval penetration in treated tubers. Mixture of pelargonium or Allium mixed with talcm powder gave good protection for along storage period (30-40 days). Sharaby *et al.* (2014 b) found that dusting potato tubers with 1% concentration (mix with talcm powder) of Myristica, Mentha, Cymbopogon and & Ionone (monoterpene) gave the best production of fungi disease during storage.

The use of organic inhibitors in this way would render potato storage less expensive avoid cobbling cost. Also due to that these organic inhibitors in plants grow natively in abundance and readily available in our area. Therefore, the present study was conducted to investigate the effect of extracted of some medicinal and aromatic plants on storability, sprouting characters, weight loss and rotting incidence of potato tubers of Spunta cv. during storage periods at the ambient temperature for 6 months period.

MATERIALS AND METHODS

Storage experiment of summer potatoes were carried out at at Fac. of Agriculture laboratories, El-Mansoura University during the two successive seasons of 2013 and 2014, to investigate the effect of some extracts of medical and aromatic plants as organic inhibitors on storability behavior of potato Spunta cv. during different storage periods at ambient temperature.

Spunta cv. plants has medium maturity season (105 days to harvesting). With yellow skin and flesh colour, shallow eye depth and long and big tubers. Potato tubers were harvested from the summer crops of 2013 and 2014 seasons and transferred into laboratory, then cleaned and sized (35 -45 mm in diameter were selected for storage treatments, cured for 15 days under thick layer of rice straw.

About 20 tubers were air dried and placed in carton box, each treatment contained three boxes. 60 boxes were put in store in separated horizontal rows (20 treatments at laboratory room x3 replicate). In addition, three boxes were stored in refrigerator at 4 ^{0}C; all treatments were stored for 2, 4 and 6 months.

The different organic inhibitors were extracted from the different aromatic and medical plants (Lemon balm, Sage, Nees, Nerium, Salix and Neem plants) as powder and aqueous extract were shown in Table (1). The leaves of Sage, Lemon balm, Salix and Nerium plants and all parts of Neem plant (leaves, shoots and fruits) and park of Nees plant extract was prepared according to El-Shemy *et al*. (2007).

The randomized complete block design with three replications was adopted, 21 treatments of experiment were as follows:-

1- Control (room temperature storage without any treatments).
2- Dipping the tubers in the water for five minutes.
3- Cold storage (4^{o}C).
4- Dipping the tubers in aqueous extract of Lemon balm plants.
5- Dusting the tubers by using powder of Lemon balm plants.
6- Dipping and dusting the tubers by Lemon balm extract.
7- Dipping the tubers in aqueous extract of Sage plants.
8- Dusting the tubers by using powder of Sage plants.
9- Dipping and dusting the tubers by Sage extracts
10- Dipping the tubers in aqueous extract of Nees plants.
11- Dusting the tubers by using powder of Nees plants.
12- Dipping and dusting the tubers by Nees plants extracts.
13- Dipping the tubers in aqueous extract of Nerium plants.
14- Dusting the tubers by using powder of Nerium plants.
15- Dipping and dusting the tubers by Nerium extracts plants.

Table (1) The principal components of extracts of medicinal and aromatic plants. Lamiaceae

Arabic name	English name	Family	Scientific name	Using part	Chemical constituents of using parts
المليسا	**Lemon balm**	Lamiaceae	*Melissa officinali*	Leaves and branches	Citral 48%-citronella 39.47%-caryophyllene 2.37%- alpha-pinene(2.86%),beta-pinene(11.37%), linalool (2.73%), citronella (5.86%) , borneol (0.62%), neral (12.22%) and geraniol (38.13%) **(Moradkhani *et al*., 2010).**
المريمية	**Sage**	Lamiaceae	*Salvia officinalis*	Leaves and branches	Cis-thujone (65.5%), 1,8-cinole (59.0%), camphor (45.7%), trans-thujone (40.1%), humulene(33.7%) linanlool (35.7%), germacrene D(32.9%),viridiflorol (24.0%),boreneol (15%) and limonene (20.3%) **(Genovaite *et al*., 2007).**
القرفة	**Nees**	Lauraceae	*Cinamomum cassia*	Bark	Trans-sabinene hydrate (29.8%), Z-B-ocime (17.9%), mycrene (4.6), a-pinene(3.1%) and B-sabinene (2.3%), among 21 sequiterpenes (32.9%),the major ones were germacrene A(11.3%) and a-gurjunene (4.7%) **Showkat *et al*. (2004)**.
الدفلة	**Nerium**	Apocyaneceae	*Nerium oleander*	Leaves	Glycosides, Neriin, Alkaloid, Oleandrin, a-tocopherol, Adyregenin, Triterpenoids, Aresin tannins, Glucose, Paraffin, Ursolic acid, Vitamin C and An essential oil **(Garima and Batra, 2010).**
الصفصاف	**Salix**	Salicaceae	*Salix spp*	Leaves and branches	2(H)-benzofuranone-5,6,7,7a-tetrahydro-4,4,7a-trimethyl(a volatile terpene:23.1%)and pentadecanoic acid-14-methyl-methyl ester(a monomethyl branched acid:8.2%).6,10,14-trimethyl-2-pentadecanone(a phytone ketone:4.2%), phytol(3,7,11,15-tetramethyl-2-hexadencen-1-01)an acyclic terpenoid(1.9%),and 1-nonadecanol(aphenolic compound with monofounctional alkanes or 1-alkanols:1.4%) (**Salem *et al*., 2011).**
النيم	**Neem**	Maliaceae	*Azadirachta indica*	Leaves, branches and fruits	The volatile oil 0.07% contained 85% caryophyllene. The lipid yield of Neem powder was 12% which composed of equal quantity saturated (polmitic 31.76%) and linoleic 18.57%and oleic 9.74%(**Narsing *et al*., 2014).**

10- Dipping the tubers in aqueous extract of Salix plants.
11- Dusting the tubers by using powder of Salix plants.
12- Dipping and dusting the tubers by Salix extracts plants.
13- Dipping the tubers in aqueous extract o Neem plants.
14- Dusting the tubers by using powder of Neem plants.
15- Dipping and dusting the tubers by Neem extracts plants.

The tubers were treated with extracts 2 times, the first was at onset of storage and the second one was applied after 30 days.

Studied characters:

At different times 2, 4 and 6 months from the beginning of storage the potato tubers were checked as follows:-

1-Sprouting %

Every 60 days throughout storage period number of sprouted tubers was recorded for the whole tuber of each box then sprouting % calculated as follows:

$$\textbf{Sprouting \%} = \frac{\text{No. of. sprouted tubers}}{\text{No. of total tubers}} \times 100$$

2-Weight Loss (%):

All tubers weighted at the beginning of storage, the damaged tubers were excluded, it was calculated at different storage periods (2,4 and 6 months) as follows :

$$\textbf{Weight Loss \%} = \frac{\text{Initial weight - weight after storage at different times}}{\text{Initial weight}} \textbf{ x100}$$

3- Damage (%):

Every 60 days throughout storage period boxes were opened, the damaged and decayed tubers were excluded out and the damage % was calculated as follows :

$$\textbf{Damage \%} = \frac{\text{No. of total tubers - No. of still ones at the storage (healty/box)}}{\text{No. of total stored tuber's (20 tubers)}} \text{ x } 100$$

Statistical analysis:

Data were tested by analysis of variance according to Gomez and Gomez (1984). Duncan's multiple range test was used for comparison among treatment means (Duncan, 1955).

RESULTS AND DISCUSSION

The results are introduced to clarify *the effect of some ground or* aqueous *of different medicinal and aromatic plants as post-harvest treatments* under separate headings which include sprouting %, sprouts number and weight, weight loss % and damage %, as follows:

1.Sprouting %:

Data presented in Table (2) indicate that all treatments of different of medicinal and aromatic extracts significantly suppressed the incidence of sprouting behavior at different periods of storage at the ambient temperature in both seasons. It was obvious from the data that sprouting % increased by increasing the storage period, the highest values were obtained from control, Neem and Salix aqueous extracts, while the lowest ones were obtained from cold storage and lemon balm powder plus aqueous extract at all storage periods (2, 4 and 6 months). The other treatments had intermediate values in both seasons. These results may be due to cold storage conditions can reduce metabolic activity, respiration rates and aging in tubers and consequently prolonged natural dormancy. Also the decreasing of sprouting percentage as affected by post-harvest of different medicinal and aromatic extracts powder plus aqueous extracts may be due to the principal components of these volatiles essential oils of treatments plants powder or aqueaus extracts presented in Table (1). Similar results were obtained by Fathy *et al.* (2005), Elsadr and Waterer (2005), Suhag *et al*. (2006), Sanli *et al*. (2010), Amoah *et al*. (2011), El-Awady *et al.* (2011), Teye *et al*. (2011), Tartoura *et al.* (2012 b), Castillo *et al*. (2013), Bibah (2014). El-Awady *et al*. (2014) studied the effect of anti-sprouting agent gerainol, camphor, citral, linalool at different concentrations (4, 6 and 8 mm) on weight losses and

damage %.They showed that potato tubers treated with geraniol or citral at concentration 6 or 8 mm decreased the sprouting percentage at the end of storage period (120 days) compared to control. *Tortoe et al. (2015*) *studied the effect of plant extracts from coca pod, potash, neem seed, neem leaves and sweet potato leaves and sweet potato leaves to inhibit bud and sprout formation in yams (Dioscoreo spp.). They found that the best plant extracts in reducing sprouting were potash, neem seed and neem leaves at 600ppm compared to other plant extracts.*

2.Sprouts number:

Data presented in Table (3) indicated that the differences among treatments were highly significant in both seasons, the highest sprouts number were obtained from control and Neem aqueous extracts at all storage periods (2, 4 and 6 months) in both seasons. It was obvious of the table that the sprouts number was increased by increasing the storage periods on the other side the lowest sprouts number was obtained from cold storage treatment in both seasons. The powder plus aqueous extract of

Table (2): Effect of the storage treatments on sprouting % of potato tubers at different storage periods during 2013 and 2014 seasons .

Treatments	Sprouting (%)					
	2013 season			2014 season		
	Storage period (months)					
	2	4	6	2	4	6
Control	38.00 a	60.33a	76.53 a	39.52 ab	62.00 a	77.86 a
Water	35.76a	58.83a	74.80 ab	37.50 bc	60.70 a	77.36 a
Cold storage	0.00 l	0.00 g	1.66 n	0.00 m	0.00 j	2.33 m
Lemon balm powder	23.10 ij	35.66 f	53.66lm	24.23 l	37.63 i	55.76 jl
Lemon balm extract	14.00 hi	36.00 f	54.80 jl	26.1 jl	37.46 i	56.60 ij
Lemon balm powder + extract	21.26 j	34.23 f	53.10 m	23.46 l	35.90 i	54.40 l
Sage powder	26.73 fg	41.00 e	57.13 ij	28.63 hi	43.86 gh	59.70 i
Sage extract	27.76 fg	42.16 e	60.20 hi	30.66 gh	46.53 fg	63.50 h
Sage powder + extract	25.80 gh	40.40 e	56.73 jl	27.93 jl	42.53 h	58.86 ij
Ness powder	29.30 de	44.16 de	62.70 gh	31.60 fg	47.20 fg	65.00 gh
Ness extract	32.36 cd	46.86 d	64.56 fg	34.30 de	49.40 ef	66.86 fg
Ness powder+ extract	28.33 ef	42.73 e	60.26 hi	30.36 hi	46.26 fg	63.53 h
Nerium powder	32.03 cd	50.76 c	67.33 de	34.10 ef	52.66 de	69.50 de
Nerium extract	33.93 bc	53.56c	69.56 cd	37.13 bc	55.83 cd	71.63 cd
Nerium powder+ extract	29.36 de	51.13 c	65.80 ef	31.06 gh	52.93 de	68.33 ef
Salix powder	33.76 bc	53.96 bc	70.60 cd	35.26 cd	56.53 bc	72.60 bc
Salix extract	37.53 a	56.96 ab	72.90 bc	38.96 ab	58.60 ab	75.23 ab
Salix powder+ extract	31.30 cd	51.70 c	68.36 de	33.56 ef	54.83 cd	70.10 de
Neem powder	33.80 bc	53.46 bc	71.96 bc	35.96 cd	55.73 cd	74.40 ab
Neem extract	38.66 a	58.16 a	74.53 ab	41.03 a	60.46 ab	76.30 ab
Neem powder+ extract	31.76 cd	52.00 c	70.56 cd	34.76 cd	55.66 cd	73.03 bc
F. test	**	**	**	**	**	**

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test.

Sage plants tended to have the best results of sprout number. Such results may be due to these treatments prevent the respiration rate of tubers

and increased the rest period of buds. These results are in agreement with these obtained by Arras *et al*. (1993) , Singh *et al*. (2005), Sanli *et al*. (2010) and Bibah (2014) .

3.Sprouts weight:

The results in Table (4) showed the effect of powder or aqueous extracts or powder plus aqueous had highly significant effect of sprouts weight at all storage periods (2, 4 and 6 months) in both seasons. The sprouts weight was increased by increasing the storage periods. Such data indicated that control had the highest weight of sprouts at all storage periods (2, 4 and 6 months) in both seasons. In adverse the lowest sprouts weight were obtained from cold storage and lemon balm followed by sage and nees powder plus aqueous extracts at all storage periods in both seasons, other treatments had intermediate values in both seasons. These results were accordance with Sanli *et al*. (2010), Teye *et al*. (2011), Tartoura *et al.* (2012 b), Bibah (2014). *Tortoe et al.* (2015) found that sweet potato tubers treated with neem extract recorded the lowest sprouts weight when compared to other treatments.

Table (3): Effect of the storage treatment on sprouts number of potato tubers at different storage periods during 2013 and 2014 seasons.

Treatments	Sprouts number					
	2013 season			2014 season		
	Storage period (months)					
	2	4	6	2	4	6
Control	23.00 a	36.00a	45.00 a	24.33 a	37.33 ab	48.33 a
Water	14.33cd	37.66cd	37.66 cd	15.66 de	23.33 hi	40.00 bc
Cold storage	0.00 j	0.00 j	2.33 j	0.00 j	0.00 m	3.33 j
Lemon balm powder	7.33 hi	14.33 hi	27.66 hi	8.33 h	16.00 jl	31.33 hi
Lemon balm extract	11.66 de	21.66 ef	31.33 ef	12.33 fg	23.66gh	35.33 ef
Lemon balm powder + extract	6.33 hi	19.00 fg	31.33 ef	8.33 h	20.66 i	30.33 i
Sage powder	9.00 gh	18.33gh	28.66 gh	12.33 fg	19.66 ij	31.00 hi
Sage extract	9.66 fg	21.66 ef	31.66 ef	14.66 de	23.00 hi	33.33 gh
Sage powder + extract	5.66 i	12.33 i	26.33 i	11.33 gh	14.33 a	30.00 i
Ness powder	10.33 ef	21.66 ef	29.33 fg	13.33 ef	24.33 hg	32.00 hi
Ness extract	10.33 ef	23.33 de	32.33 de	14.33 de	25.66 fg	34.66 fg
Ness powder+ extract	9.66 fg	19.33 fg	27.66 hi	12.33 fg	22.33 hi	30.33 i
Nerium powder	13.33 de	26.33 cd	34.33 de	15.66 de	28.33 de	37.00 de
Nerium extract	14.66 cd	30.33 bc	40.66 ab	17.33 cd	31.66 cd	43.00 ab
Nerium powder+ extract	13.33 de	27.66 bc	33.33 de	15.00 de	29.66 cd	36.33 ef
Salix powder	13.66 ed	28.33 bc	32.33 de	15.33 de	30.66 cd	38.33 cd
Salix extract	13.66de	30.33 bc	35.33 cd	17.00 cd	34.00 bc	39.66 cd
Salix powder+ extract	12.66 de	24.33 de	37.33 cd	15.33 de	26.33 ef	35.66 ef
Neem powder	18.33 bc	36.33 a	41.33 ab	20.33 bc	37.00 ab	44.33 ab
Neem extract	19.66ab	37.00 a	44.00 ab	22.66 ab	39.66 a	46.00 ab
Neem powder+ extract	15.66cd	32.00 ab	38.66 bc	17.66 cd	34.33 bc	41.00 bc
F. test	**	**	**	**	**	**

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test.

4. Weight loss %:

Data in Table (5) show that the weight loss % was increased with the increment of storage period (2, 4 and 6 months) at ambient temperature. The cold storage treatment was the best one of all treatments as had the lowest values in both seasons. On the other hand, the highest values were obtained

from control treatment at all sampling dates (2, 4 and 6 months) in both seasons. The best weight loss % of tubers which treated with lemon balm, sage followed by nees treatments as post-harvest at the ambient temperature.

Table (4): Effect of the storage treatment on sprouts weight of potato tubers at different storage periods during 2013 and 2014 seasons.

Treatments	Sprouts weight (g)					
	2013 season			2014 season		
	Storage period (months)					
	2	4	6	2	4	6
Control	14.66 a	17.90 a	21.10 a	15.46 a	19.10 a	22.36 a
Water	8.83 bc	12.06 cd	19.56 ab	9.46 cd	12.30 ef	20.46 ab
Cold storage	0.00 i	0.00 l	3.66 i	0.00 j	0.00 m	4.33 g
Lemon balm powder	4.26 gh	6.30 g	11.46 gh	4.86 hi	6.50 l	13.53 ef
Lemon balm extract	5.40 fg	9.26 hi	14.06 de	6.30 fg	9.96 hi	15.36 de
Lemon balm powder + extract	3.56 h	7.26 ij	11.33 gh	4.66 i	7.86 jl	12.40 f
Sage powder	4.73 g	7.60 ij	12.43 fg	5.83 gh	9.73 ij	13.80 ef
Sage extract	4.63 gh	10.80 gh	13.06 ef	6.90 ef	12.90 ef	14.36 de
Sage powder + extract	3.63 h	6.86 j	12.26 fg	4.86 hi	7.40 l	13.40 ef
Ness powder	5.80 ef	11.33 ef	12.90 ef	7.40 de	12.50 ef	14.70 de
Ness extract	5.53 fg	11.16 fg	14.33 cd	6.50 fg	12.13 fg	15.70 cd
Ness powder+ extract	4.43 gh	9.23 hi	10.36 h	6.56 fg	11.46 gh	12.56 f
Nerium powder	8.03 bc	12.33 cd	17.53 ab	9.63 cd	14.66 cd	18.30 ab
Nerium extract	9.03 bc	13.90 bc	18.06 ab	10.63 bc	16.30 bc	20.80 ab
Nerium powder+ extract	7.80 bc	12.40 cd	14.46 cd	8.86 cd	13.30 de	16.30 bc
Salix powder	6.40 cd	13.60 bc	14.63 cd	7.53 de	15.43 bc	16.06 bc
Salix extract	6.20 de	15.33 b	16.23 bc	7.40 de	16.83 bc	17.40 ab
Salix powder+ extract	6.50 cd	11.70 de	17.50 ab	8.50 cd	13.03 de	18.36 ab
Neem powder	8.30 bc	13.36 bc	17.20 ab	10.13 bc	13.56 de	19.10 ab
Neem extract	10.16 b	14.23 bc	18.53 ab	12.40 b	14.40 cd	20.83 ab
Neem powder+ extract	7.46 cd	11.43 ef	15.73 bc	8.60 cd	14.50 cd	17.86 ab
F. test	**	**	**	**	**	**

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test.

Concerning with Salix extract after 2 months after 4 months and Neem extract after 6 months treatments of storage period gave the intermediate values. Generally, stored potatoes in the refrigerator at 4°C and relative humidity of 85% were suitable for potato storage for more than 6 months in good condition and without sprouting. But, storage of potato tubers at high temperature without treatment (control), increases the chance loss of moisture and shrinkage. Also, it speeds up from a broken dormancy and sprouting potato tubers, leading to increase the rate of shrinkage, because sprouting is accompanied by movement of carbohydrates to the new sprouts and increased a rate of respiratory with the loss of moisture from these sprouts by transpiration. Loss in moisture is greater up to 90% of the total loss in weight while loss in the dry matter as a result of respiration in the range of 10% of the dry weight (Hasan, 1999). Similar results about using natural safe essential extracts of medicinal and aromatic for controlling weight loss % of potatoes during storage were obtained by Okigbo and Nmeka (2005), Bulus *et al*. (2006), El-Sayed *et al*. (2006), Sanli *et al*. (2010) El-Awady *et al*. (2011), Sharma (2012), Sharaby *et al.* (2014 a and b).

Concerning with extracts of plants, many investigator found that these plants were most effective treatments for preventing weight loss compared with control El-Awady (2002), Suhag *et al*. (2006), Sanli *et al*. (2010), Teper–Barmnolker *et al.* (2010), El-Awady *et al.* (2011), Teye *et al*. (2011), Ghossan *et al*. (2012), Rahman *et al.* (2012) and Tartoura *et al.* (2012 b) and Bibah (2014).

5.Damage %:

Data presented in Table (6) clear that the damage % of potato tubers was increased by increasing the storage period (2, 4 and 6 months). The cold storage and lemon balm followed by sage and nees treatments (powder, aqueous extract and powder plus aqueous extract) had the best results of damage as had the lowest values in both seasons, on the other hand the highest values were obtained from control and water treatments as the differences were highly significant in both seasons.

Concerning with Nerium, Salix and Neem extracts treatments of storage period gave the intermediate values. These results may be due to the cold storage and lemon balm treatments had reduced the damaged of tubers by reducing growth of bacteria and fungi which caused the damage. Similer results were obtained by Jobing (2000), Chowdhury (2002), El-Awady (2002), Fathy *et al.* (2005), Okigbo and Nmeka (2005), Bulus *et a*l. (2006), Amienyo and Ataga (2007), El-Sayed *et al.* (2007), Aboel-Seoud *et al.* (2010), Singh (2011), Bhardwai (2012), Ghassan *et al*. (2012), Tartoura *et al.* (2012 b), Ilesanmi and Gungula (2013) and Bibah (2014).

Table (5): Effect of the storage treatments on Weight loss % of potato tubers at different storage periods during 2013 and 2014 seasons.

Treatments	Weight loss (%)					
	2013 season			2014 season		
	Storage period (months)					
	2	4	6	2	4	6
Control	9.0 a	14.6 a	24.1 a	5.13 a	19.60 a	22.4 a
Water	5.4 de	11.1 bc	16.0 cd	3.90 bc	9.20 c	16.80 ab
Cold storage	3.7 g	6.4 f	9.7 h	0.81 f	2.10 d	2.90 e
Lemon balm powder	4.9 fg	9.7 cd	13.7 fg	2.83 e	9.03 c	14.36 bc
Lemon balm extract	5.3 ef	9.3 de	15.6 de	3.30 bc	9.20 c	16.53 ab
Lemon balm powder + extract	5.8 cd	9.4 de	12.2 g	3.00 cd	9.10 c	16.26 ab
Sage powder	5.3 ef	9.1 e	16.2 bc	2.83 d	8.06 c	13.30 d
Sage extract	5.4 de	11.1 bc	12.3 g	3.10 bc	8.30 c	15.73 ab
Sage powder + extract	6.0 bc	11.3 bc	13.3 fg	3.30 bc	8.56 c	15.60 ab
Ness powder	5.7 cd	11.4 bc	16.3 bc	3.23 bc	9.33 bc	16.60 ab
Ness extract	5.8 cd	11.8 b	16.3 bc	3.23 bc	9.06 c	16.40 ab
Ness powder+ extract	5.5 de	11.0 bc	14.6 ef	3.30 bc	8.66 c	15.26 cd
Nerium powder	7.8 ab	11.5 bc	18.0 b	3.36 bc	10.23ab	17.50 ab
Nerium extract	7.2 ab	12.6 b	17.3 bc	3.93 bc	11.36 ab	18.10 ab
Nerium powder+ extract	7.0 bc	12.2 b	16.9 bc	3.40 bc	9.80 ab	16.90 ab
Salix powder	6.4 bc	12.3 b	17.5 bc	3.90 bc	9.66 ab	16.40 ab
Salix extract	6.0 bc	12.0 b	17.4 bc	4.13 b	10.10 ab	17.23 ab
Salix powder+ extract	7.3 ab	11.7 b	16.8 bc	3.70 bc	9.40 bc	18.48 ab
Neem powder	7.5 ab	11.0 b	16.6 bc	3.73 bc	9.36 bc	18.83 ab
Neem extract	6.6 bc	12.0 b	16.6 bc	3.76 bc	11.56 a	19.03 a
Neem powder+ extract	6.4 bc	11.7 b	17.6 bc	3.90 bc	10.10 ab	18.23 ab
F. test	**	**	**	**	**	**

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test.

Table (6): Effect of the storage treatments on Damage % of potato tubers at different storage periods during 2013 and 2014 seasons .

Treatments	Damage (%)					
	2013 season			2014 season		
	Storage period (months)					
	2	4	6	2	4	6
Control	7.00 a	8.5 a	10 .0 a	5.5 a	8.0 a	11.0 a
Water	5.00b	6.0 b	7.0 b	4.0 b	6.0 b	7.00 c
Cold storage	0.00 e	0.00 f	1.2 f	0.00 d	0.00 f	1.1 g
Lemon balm powder	0.00 e	0.00 f	1.73 f	0.00 d	1.66e	3.33 e
Lemon balm extract	0.00 e	0.00 f	1.73 f	0.00 d	1.73 e	1.73 f
Lemon balm powder + extract	0.00 e	1.66 e	1.73 f	0.00 d	0.00 f	0.00 h
Sage powder	0.00 e	1.73 e	1.73 f	1.66 c	1.73 e	1.73 f
Sage extract	0.00 e	1.73 e	3.70 e	1.66 c	1.73 e	3.40 e
Sage powder + extract	0.00 e	3.50 d	3.50 e	1.66 c	1.73 e	1.73 f
Ness powder	1.66 d	3.33 d	3.73 e	0.00 d	1.66 e	1.73 f
Ness extract	1.66 d	1.73 e	3.50 e	0.00 d	1.73 e	1.73 f
Ness powder+ extract	1.66 d	1.73 e	1.73 f	0.00 d	1.73 e	1.73 f
Nerium powder	1.66 d	3.50 d	4.79 d	1.66 c	3.33 d	5.00 d
Nerium extract	3.33 c	3.50 d	5.16 cd	1.66 c	3.40 d	6.83 c
Nerium powder+ extract	1.66 d	3.33 d	3.40 e	1.66 c	5.06 c	8.50 b
Salix powder	5.00 b	5.16 c	5.23 cd	1.66 c	1.73 e	3.40 e
Salix extract	1.66 d	5.06 c	5.56 c	1.66 c	3.46 d	5.06 d
Salix powder+ extract	3.33 c	3.50 d	5.16 cd	1.66 c	1.76 e	3.50 e
Neem powder	1.66 d	5.16 c	5.16 cd	3.33 d	3.46 d	7.0 c
Neem extract	3.33 c	3.33 d	3.50 e	1.66 c	1.73 e	3.50 e
Neem powder+ extract	1.66 d	3.33 d	3.70 e	1.66 c	1.73 e	5.13 d
F. test	**	**	**	**	**	**

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test.

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تأثير مستخلصات بعض النباتات الطبية والعطرية على القدرة التخزينية للبطاطس على درجة حرارة الغرفة

١- التزريع ونسبة الفقد فى الوزن والتالف.

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أجريت تجارب التخزين على محصول البطاطس الصيفى في معمل كلية الزراعة جامعة المنصورة خلال موسمى ٢٠١٣ و٢٠١٤ بهدف دراسة تاثير بعض مستخلصات النباتات الطبية و العطرية (المليسيا والمريمية والقرفة والدفلة والصفصاف والنيم) فى صورة مسحوق أو مستخلص مائى كمثبطات تزريع طبيعية على صنف البطاطس أسبونتا على درجة حرارة الغرفة خلال ٢ و٤ و٦ شهور من التخزين وكان عدد المعاملات المستخدمة ٢١ معاملة فى نظام قطاعات كاملة العشوائية.

ويمكن تلخيص اهم النتائج المتحصل عليها كالآتي:-

وقد أظهرت النتائج أن معاملة التخزين فى الثلاجات وكذلك المعاملة بالمليسيا يليها المعاملة بالمريمية والقرفة كمسحوق أو مستخلص مائى أو كلاهما بدون وجود أى أختلافات معنوية بينهم أنخفاض معنويا فى نسبة التزريع و الفقد فى الوزن و كذلك نسبة التلف فى حين سجلت معاملة الكنترول أعلى معدل بهذا الخصوص. كما تشير النتائج ان معاملة الكنترول ومعاملة النيم كمستخلص مائى أعلى معدل لوزن وعدد النبوت تحت درجة حرارة الغرفة خلال موسمى الدراسة . وعموما توصى الدراسة بأن:

- افضل نسبة تزريع واقل معدل فقد فى الوزن الطازج للدرنات البطاطس المخزنة على درجة حارة الغرفة والتى عوملت بالميليسا والمريمية والقرفة مقارنة بالكنترول والمعاملات الاخرى خلال فترات التخزين المختلفة.
- التخزين بواسطة الزيوت العطرية الطيارة يعتبر كطريقة بديلة للتخزين فى الثلاجات والنوالات اذاكان الغرض الاستهلاك والتصنيع واستعمال الدرنات المخزنة كتقاوى. ولذا يعتبر هذا التكنيك مهم فى تخزين درنات البطاطس عضويا بدون اللجوء الى استخدام الكيماويات كمانعات للتزريع عندما تكون سعة الثلاجات غير كافية او قليلة جدا.

واخيرا توصى الدراسة بعمل دراسات مستقبلية على باقى مستخلصات النباتات العطرية والطبية املا فى ايجاد مستخلص او أكثر فعال فى خفض نسبة التزريع وبالتالى يمكن فيما بعد عمل خلطة مناسبة لعدم التزريع وزيادة كفاءة تخزين الدرنات.