World Journal of Dairy & Food Sciences 9 (2): 299-307, 2014
ISSN 1817-308X

DOI: 10.5829/idosi.wjdfs.2014.9.2.1144

Influence of Some Medicinal and Aromatic Plants Addition on Pan Bread Quality

Hinar A. Seleem and *Zahrat El-Ola M. Mohamed*

Department of Crops Technology Research,
Food Technology Research Institute, Agricultural Research Center, Giza, Egypt

Abstract: The aim of this study was to investigate the effect of adding some aromatic and medicinal plants (garlic, coriander, sumac, fennel, marjoram, thyme and cardamom) as natural antioxidants and antimicrobial agents on pan bread characteristics. The selected plants were used at 2% of wheat flour (w/w). Physicochemical parameters, sensory evaluation and shelf life of pan bread were examined. The results showed that the addition of some aromatic and medicinal plants slightly increased fiber and ash but did not affect on protein or fat content. The addition of coriander and cardamom plants slightly improved the textural properties of produced pan bread particularly the firmness character. Freshness of the produced pan bread was improved significantly during the storage periods compared with control. The addition of selected aromatic and medicinal plants to pan bread enhanced the odor character compared with control with no adverse effect on other sensory attributes. In addition, all pan bread samples exhibited higher antioxidant activity than control. Aromatic and medicinal plants addition was able to inhibit the growth of mould, prolonged the storage periods of pan bread compared with control.

Key words: Medicinal and Aromatic Plants · Pan Bread · Antioxidant Activity · Sensory Evaluation · Freshness

INTRODUCTION

Medicinal herbs have been widely applied in various industrial branches such as pharmaceutical, cosmetical, chemical, etc. Regarding food industry, aromatic plants and their essential oils have been used extensively as flavor ingredients in a wide variety of foods, beverages and confectionery products [1]. Medicinal and aromatic herbs not just influence the taste and flavor of the product but have a beneficial effect on human organism. Herbal extracts contain etheric oils and other active substances such as tannins, organic acids, enzymes, resins, pigments, vitamins, minerals, mucous substances, etc. that enhance aroma and improve nutritive value of a product. For this reason, these substances can be used as safe and effective alternatives to synthetic preservatives [2]. Medicinal and aromatic plants have been recognized to possess biological activities, including antibacterial, antifungal and antioxidant properties. Several spices (cinnamon, clove and marjoram), herbs (thyme, sage, oregano, rosemary, fennel and basil) and fruits (berries) contain volatile antimicrobial compounds [3]. The aromatic plants are widely used for their antioxidant activities and as alternative to synthetic preservatives [4, 5]. Marjoram is one of the most familiar kitchen herbs. It is cultivated for use of its aromatic leaves for flavoring and other culinary purposes. The medicinal effects of marjoram are gastrointestinal tract stimulant, tonic, carminative, diaphoretic, hypoglycemic, diuretic as well as antibacterial [6] and as antioxidant [7]. The dried fruit cardamom is used either whole or in ground form as a flavoring agent and also in the medicinal preparations [8]. Coriander has much importance due to its versatile use as an herb as well as a spice [9].

Sumac (*Rhus coriaria*) is famously used in the Mediterranean region and Middle East as a spice, sauce and drink [10]. Furthermore, Garlic is commonly used as flavoring, culinary and herbal remedies qualities [11]. *Thymus* species, as well as their applications in various commercial preparations, mainly as antimicrobial and antioxidant agents [12, 13]. Mature fruit and essential oil of Fennel are used as a constituent of pharmaceutical and cosmetic products. They are also used as flavoring agents in food products [14]. Bakery products are widely consumed and are becoming a major component of the international food market [15]. Bread is the main staple

Corresponding Author: Zahrat El-Ola M. Mohamed, Department of Crops Technology Research, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt. E-mail: zahoramahmoud@yahoo.com.

food meeting nutritional needs of humans in the world. Bread supplies a significant portion of the nutrients required for growth and maintenance of health. It is also one of the sources of proteins, vitamins, minerals, fiber and complex carbohydrates [16]. Physicochemical changes (e.g. staling, firming) and microbiological spoilage shorten the shelf life of bread [17]. Bread staling results in decreased consumer acceptance of bakery products [18].

The objectives of this study were to produce pan bread with addition of some aromatic plants as garlic, coriander, sumac, fennel, marjoram, thyme and cardamom and to study the effect of these additions on physicochmeical, sensory properties as well as shelf life of the produced pan bread.

MATERIALS AND METHODS

Materials: Wheat flour (WF, 72% extraction) was obtained from Five Stars Company, Swiss City, Egypt. Ingredients such as sugar, salt, instant active dry yeast and olive oil were purchased from the local market. Bread improver was obtained from Al-Khatib Company, Giza, Egypt. Dried medicinal and aromatic plants [garlic (*Allium sativum*), coriander (*Coriandrum sativum)*, sumac (*Rhus coriaria*), fennel (*Foeniculum vulgare*), marjoram (*Origanum majorana*), thyme (*Thymus vulgaris*) and cardamom (*Elettaria cardamomum*)] were purchased from Giza Company for seeds and medicinal plants, 6th October City, Egypt.

Preparation of Pan Bread: A straight dough bread making process was performed according to AACC [19], basic dough formula was consisted of flour (100 g), salt (1 g), dry yeast (4 g), sugar (4 g), bread improver (0.1 g), olive oil (10 g), Medicinal and aromatic plants added at level 2% and the required amount of water. The dough was put into greased fermentation bowel and placed in a fermentation cabinet at 37°C and a relative humidity 80-85% for 20 min and then dough divided into pieces of 125 g. The dough was proofed for 30 min in a fermentation cabinet under controlled temperature and a relative humidity and then baked for 20 min at 240°C in an electric oven. The pan bread was separated from the metal pans, left for cooling at room temp.

Analytical Methods: Proximate Chemical Analysis of Pan Bread: Moisture, crude protein, crude fat, crude fiber and carbohydrate (by difference) were evaluated according to A.O.A.C. [20].

Physical Measurements of Pan Bread: Bread loaf weight (g) was recorded after cooling for 1h, bread loaf volume (cm^3) was determined by rapeseed displacement method as described by AACC [19]. Specific volume (cm^3/g) of bread was calculated by dividing volume by weight. Density (g/cm^3) was calculated by dividing weight by volume.

Texture Profile Analysis (TPA) of Pan Bread: Bread texture was determined by universal testing machine (Conetech, B type, Taiwan) provided with software according to Bourne [21]. An aluminum 25 mm diameter cylindrical probe was used in a TPA double compression test to penetrate to 50% depth, at 1mm/s speed test. Firmness (N), gumminess (N), chewiness (N), cohesiveness and springiness were calculated from TPA graphic.

Antioxidant Activity Assays: The DPPH (2, 2-diphenyl-1-picrylhydrazyl) radical scavenging activity of methanolic extracts was determined following the method reported by Tepe *et al.* [22].

Sensory Evaluation of Pan Bread: Samples of pan bread were evaluated by 10 panelists (staff in Food Technology Research Institute, Agricultural Research Center, Giza, Egypt). Crust color (10), crumb color (20), taste (15), odor (15), texture (20) and general appearance (20). The total score of these sensory properties was evaluated as overall acceptability [23]

Freshness of Pan Bread: The freshness of each packed samples (pan bread) was measured at room temperature during storage (24, 48 and 72h) by alkaline water retention capacity (AWRC) according to method of Yamazaki [24], as modified by Kitterman and Rubenthaler [25]

Total Fungal Count of Pan Bread: Total fungal counts of pan bread (1 g sample) were determined using malt yeast agar media according to Mislivec *et al*. [26] and Swanson *et al*. [27]. Shelf life of the produced pan bread was taken as the total fungal count during storage. $\geq 10^5$ $cfu.g^{-1}$ indicated the spoilage of the sample. The samples were stored for 7 days. Fungal growth was periodically determined during storage time.

Statistical Analysis: For the analytical data, mean values and standard deviation are reported. The data obtained were subjected to one-way analysis of variance (ANOVA) at $P<0.05$.

RESULTS AND DISCUSSION

Chemical Composition: Proximate chemical composition of the pan bread samples containing different selected aromatic and medicinal plants are presented in Table 1. The results showed that there were no significant changes in protein and fat contents of pan bread samples with the addition of different medicinal and aromatic plants. Protein content ranged from 11.45 % (sample 5) to 12.2 % (sample while fat content ranged from 9.16% (sample 6) to 9.66 % (sample 7). Meanwhile, the results indicated that the ash content increased in all samples compared with control (sample 1). Sample 8 containing thyme had a significantly higher content of ash (1.78 %) relative to control (1.15%). Hamza *et al*. [28] reported that thyme had higher ash content (11.76%). Regarding to fiber content, results indicated that there was significantly increased in fiber content in all samples compared with control. The crude fiber content of pan bread samples was ranged from 0.42 to 0.63%. Furthermore, carbohydrate content ranged from 75.74 to 77.47% and almost there were no significant differences between pan bread samples in carbohydrate content. These results are in agreement with those obtained by Hussein *et al*. [29].

Physical Properties: Physical attributes (loaf weight, loaf volume, specific volume and density) of pan bread samples are given in Table 2. From the results, it could be observed that no significant difference between control and other samples in bread loaf weight values and it was ranged between 113.5 and 116.0 g, while the loaf volume was increased in the most pan bread containing the selected herbs particularly in case of sample 7 (cardamom pan bread) which had the highest loaf volume 437.5 cm^3 followed by sample 8 (thyme pan bread) 418 cm^3 and sample 5 (marjoram pan bread) 416 cm^3. Concerning to specific volume (cm^3/g), the results indicated that cardamom pan bread had the highest specific volume (3.82 cm^3/g) relative to other samples. On the other hand, density of pan bread samples decreased compared with control except for garlic and sumac pan bread (0.32 and 0.33 g/cm^3, respectively). Cardamom pan bread had the lowest density value (0.26 g/cm^3).

The obtained results are also in the same trend of Simurina *et al.* [30].

Texture Profile Analysis (TPA): Texture profile analysis (TPA) [firmness, cohesiveness, gumminess, chewiness and springiness] is shown in Table 3. From the results,

Table 1: Proximate chemical composition of pan bread samples (% dry weight).

Samples	Protein	Fat	Ash	Crude fiber	Carbohydrate
1	11.92±0.31^{a}	9.33±0.17^{ab}	1.15±0.03^{d}	0.42±0.00^{d}	77.17±0.54^{ab}
2	12.01±0.42^{a}	9.23±0.18^{b}	1.43±0.17^{bcd}	0.50±0.01^{c}	76.82±0.10^{abcd}
3	11.50±0.49^{a}	9.32±0.10^{ab}	1.26±0.08^{cd}	0.56±0.01^{b}	77.40±0.74 ^{ab}
4	11.90±0.14^{a}	9.65±0.00^{a}	1.54±0.16^{abc}	0.63±0.01^{a}	76.28±0.37^{bcd}
5	11.45±0.21^{a}	9.60±0.06^{a}	1.37±0.16^{cd}	0.60±0.00^{a}	76.93±0.02^{abc}
6	11.46±0.31^{a}	9.16±0.16^{b}	1.39±0.10^{cd}	0.51±0.00^{c}	77.47±0.59^{a}
7	12.20±0.36^{a}	9.66±0.12^{a}	1.72±0.12^{ab}	0.62±0.01^{a}	75.74±0.62^{d}
8	12.14±0.16^{a}	9.52±0.19^{ab}	1.78±0.10^{a}	0.62±0.00^{a}	75.99±0.16^{cd}

Sample (1): Control pan bread, Sample (2): Garlic pan bread, Sample (3): Coriander pan bread, Sample (4): Fennel pan bread, Sample (5): Marjoram pan bread, Sample (6): Sumac pan bread, Sample (7): Cardamom pan bread, Sample (8): Thyme pan bread.

Values are means of three replicates±SD, number in the same column followed by the same letter are not significantly different at 0.05 level.

Table 2: Physical properties of pan bread samples.

Samples	Loaf weight (g)	Loaf volume (cm^3)	Specific Volume (cm^3/g)	Density (g/cm^3)
1	116.0±1.41^{a}	377.5±10.60^{bcd}	3.25±0.05^{cd}	0.31±0.01^{bc}
2	113.5±2.12^{a}	355.0±7.07^{cd}	3.03±0.06^{d}	0.32±0.00^{ab}
3	113.5±2.12^{a}	390.0±14.14^{bc}	3.44±0.06^{bc}	0.29±0.00^{cd}
4	113.5±0.70^{a}	398.5±16.26^{ab}	3.51±0.12^{b}	0.28±0.00^{d}
5	114.5±2.12^{a}	416.0±26.87^{ab}	3.63±0.16^{ab}	0.28±0.01^{de}
6	113.5±2.12^{a}	346.0±5.65^{d}	3.05±0.01^{d}	0.33±0.07^{a}
7	114.5±2.12^{a}	437.5±17.60^{a}	3.82±0.08^{a}	0.26±0.00^{e}
8	116.0±1.41^{a}	418.5±26.16^{ab}	3.61±0.17^{ab}	0.28±0.01^{de}

Sample (1): Control pan bread, Sample (2): Garlic pan bread, Sample (3): Coriander pan bread, Sample (4): Fennel pan bread, Sample (5): Marjoram pan bread, Sample(6): Sumac pan bread, Sample (7): Cardamom pan bread, Sample (8): Thyme pan bread.

Values are means of three replicates±SD, number in the same column followed by the same letter are not significantly different at 0.05 level.

Table 3: Texture profile analysis (TPA) of pan bread prepared by adding selected medicinal and aromatic plants.

Samples	Firmness (N)	Cohesiveness	Gumminess (N)	Chewiness (N)	Springiness
1	1.33±0.12^{b}	0.49±0.04^{ab}	0.65±0.00^{cd}	0.54±0.00^{bcd}	0.84±0.00^{a}
2	1.86±0.17^{a}	0.49±0.00^{ab}	0.91±0.08^{a}	0.75±0.07^{a}	0.82±0.00^{c}
3	1.18±0.10^{b}	0.54±0.00^{a}	0.64±0.05^{cd}	0.52±0.04^{cd}	0.82±0.00^{c}
4	1.68±0.21^{a}	0.47±0.00^{b}	0.79±0.10^{ab}	0.64±0.08^{ab}	0.82±0.00^{c}
5	1.24±0.12^{b}	0.50±0.02^{ab}	0.62±0.02^{cd}	0.51±0.02^{cd}	0.83±0.00^{b}
6	1.92±0.03^{a}	0.38±0.00^{c}	0.73±0.01^{bc}	0.61±0.01^{bc}	0.83±0.00^{b}
7	1.13±0.13^{b}	0.49±0.04^{ab}	0.55±0.01^{d}	0.46±0.01^{d}	0.84±0.00^{ab}
8	1.33±0.13^{b}	0.48±0.00^{b}	0.64±0.06^{cd}	0.52±0.05^{cd}	0.81±0.00^{d}

Sample (1): Control pan bread, Sample (2): Garlic pan bread, Sample (3): Coriander pan bread, Sample (4): Fennel pan bread, Sample (5): Marjoram pan bread, Sample(6): Sumac pan bread, Sample (7): Cardamom pan bread, Sample (8): Thyme pan bread.
Values are means of three replicates±SD, number in the same column followed by the same letter are not significantly different at 0.05 level.

Table 4: Baking freshness properties of pan bread samples.

Samples	Zero time	24h	48h	72h
1	152.26±2.02^{d}	111.27±5.34^{d}	109.43±1.61^{f}	77.95±4.19^{d}
2	208.56±3.77^{a}	131.64±2.09^{c}	122.74±3.03^{def}	107.29±8.52^{c}
3	205.00±2.82^{a}	133.62±2.07^{c}	117.13±7.95^{ef}	116.32±13.00^{c}
4	187.15±1.14^{b}	160.33±5.51^{b}	148.09±5.02^{b}	140.61±4.37^{b}
5	211.61±3.40^{a}	179.04±10.06^{a}	173.16±4.94^{a}	157.25±10.0^{a}
6	176.08±6.84^{c}	139.05±7.36^{c}	124.04±5.92^{de}	114.14±3.98^{c}
7	188.40±4.08^{b}	143.27±8.57^{c}	132.03±9.03^{cd}	120.81±1.36^{c}
8	180.25±1.37^{bc}	158.95±5.01^{b}	140.93±4.84^{bc}	138.51±1.93^{b}

Sample (1): Control pan bread, Sample (2): Garlic pan bread, Sample (3): Coriander pan bread, Sample (4): Fennel pan bread, Sample (5): Marjoram pan bread, Sample(6): Sumac pan bread, Sample (7): Cardamom pan bread, Sample (8): Thyme pan bread.
Values are means of three replicates±SD, number in the same column followed by the same letter are not significantly different at 0.05 level.

it could be observed that addition of medicinal and aromatic plants in formulation of pan bread samples significantly affected the textural properties of pan bread. Values of firmness non significantly decreased for samples 7, 3 and 5 (1.13, 1.18 and 1.24, respectively) compared with control sample (1.33), while samples 2 and 6 recorded the highest values (1.86 and 1.92, respectively). Moreover, there were no significant differences in cohesiveness between all pan bread samples except in case of sumac pan bread (sample 6) which had the lowest cohesiveness value (0.38). For gumminess values, the highest value was observed for garlic pan bread (0.91) and the lowest for cardamom pan bread (0.55). At the same trend in chewiness values, garlic pan bread scored the highest value (0.75) and cardamom pan bread scored the lowest value (0.46). Regarding springiness, there was a slight decrease in all formulas relative to control except for cardamom pan bread. These results in line with Hussein *et al*. [29]. Simurina *et al.* [30] reported that the addition of herbs did not significantly affect the crumb firmness in comparison with the standard white bread.

Baking Freshness: Bread staling is a complex process that occurs during bread storage. It is delayed the deterioration progress of qualities such as taste, firmness, etc. The mechanism of bread staling is still not clear yet even though it has been studied for 150 years [31]. Alkaline water retention capacity (AWRC) of the pan bread loaves could be considered as an indication for staling and freshness. Therefore, it was estimated for each selected medicinal and aromatic plants addition at zero time and after storage periods (24, 48 and 72h) as shown in Table 4. The presented data showed that in spite of that AWRC was increased as medicinal and aromatic plants addition compared to sample (1), it was decreased as the storage time increased in all the tested pan bread. Moreover, staling rate which calculated from the differences between AWRC of third and first day storage is shown in Fig. 1. The results in Fig.1 illustrated that the control sample had the highest staling rate (33.31) compared with other pan bread samples and sample 3, 4 and 8 had the lowest staling rate (17.30, 19.72 and 20.43, respectively). Sample 5 which containing marjoram had the highest value of AWRC, being, 211.61, 179.04, 173.16 and 157.25 at 0, 24, 48 and 72 h, respectively. This could be attributed to the high dietary fiber content of the marjoram powder 73.59 % [28]. Fibers improve the nutritional value of bread but usually alter the rheological properties of dough, the quality and sensory properties of the final bread product. Bread containing fiber to a greater extent show especially longer shelf life than control samples [32]. These results are in agreement with those obtained by Mehder [33].

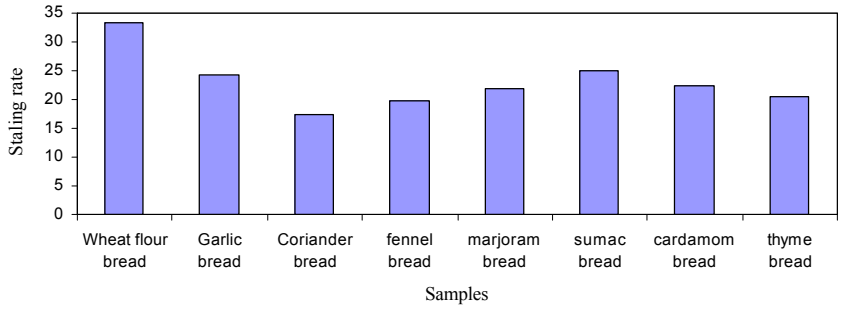

Fig. 1: Staling rate of pan bread samples.

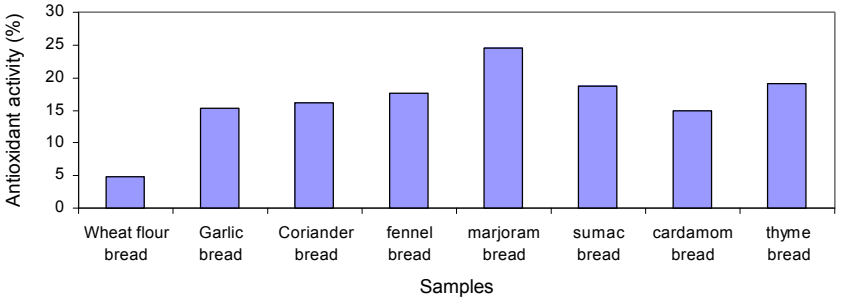

Fig. 2: Antioxidant activity of methanolic extract of pan bread.

Antioxidant Activity: Antioxidants present in food are very important for human health since the reactive oxygen species are recognized as aging and carcinogenesis factor [34]. The antioxidant activity of methanolic extracts of pan bread is shown in Fig. 2. From data in Fig. 2, it could be observed that the addition of medicinal and aromatic plants to pan bread samples increased significantly their antioxidant activity in comparison with control (4.9%). Marjoram pan bread extract had the highest antioxidant activity (24.65%) followed by thyme pan bread 19.0, while the antioxidant activity of cardamom pan bread extract was 14.85%.These results may be due to the higher antioxidant of these plants that Gramza-Michałowska *et al.* [35] reported that marjoram and thyme extracts however possessed also strong antioxidant activity. Plants, including herbs and spices, have many phytochemicals which are a potential source of natural antioxidant, e.g. phenolic diterpenes, flavonoids, alkaloids, tannins and phenolic acids [36]. One component present in aromatic plants and spices and which may act as natural antioxidants, is the corresponding essential oil [37]. These results are in agreement with those reported by Hussein *et al*. [29], who found that the addition of fennel, thyme and fenugreek showed significant increase in their antioxidant activity in comparison with control pie. Also, Das *et al*. [38] reported that a sharp increase in antioxidant content was an important beneficial fortification effect observed in the fortified breads with coriander.

Sensory Evaluation: Photographs of bread samples are illustrated in Fig. 3. Sensory evaluation score of produce pan bread are presented in Table 5. The results showed that control bread sample recorded the highest score for all attributes relative to other pan bread samples except in odor character, it was recorded the lowest score. Among all pan breads containing medicinal and aromatic, garlic pan bread had the highest score for over all acceptability (94.83%) followed by coriander pan bread (93.58%) and cardamom pan bread (92.50%), while sumac pan bread had the lowest score for over all acceptability (82.67%). From data in Table 5, it could be observed that addition of selected medicinal and aromatic plants to pan bread enhanced the odor compared with control. Garlic pan bread had the highest score for odor (14) compared with control and the other pan bread samples. This might be attributed to the higher content of volatile aromatic or essential oils in these plants. On the other hand, sumac addition reduced all sensory attributes relative to other herbs addition but still acceptable, this reduction may be due to the dark red color of sumac. Generally, it could be observed that the addition of aromatic plants to bakery products affected the highest scores of sensory evaluation Basuny *et al.* [39].

Total Fungal Count of Pan Bread and Shelf-life: Mould spoilage is a serious and costly problem for the bakery industry [40]. Fig. 4 showed the effect of addition

Fig. 3: Pan bread photographs.

Table 5: Sensory evaluation of pan bread samples.

Samples	General appearance	Texture	Crumb color	Crust color	Odor	Taste	Total score
1	19.83±0.25^{a}	19.5±0.83^{a}	19.84±0.40^{a}	9.5±0.54^{ab}	13.00±0.63^{b}	13.50±0.54^{ab}	95.17±1.63^{a}
2	18.17±0.41^{c}	19.33±0.81^{a}	19.75±0.41^{a}	9.58±0.49^{a}	14±1.05^{a}	14±0.89^{a}	94.83±2.97^{a}
3	18.17±0.41^{c}	18.91±0.80^{ab}	19.5±0.44^{a}	9.33±0.5163^{a}	13.25±0.88^{ab}	13.16±1.16^{ab}	93.58±2.97^{ab}
4	18.08±0.664^{c}	18.50±1.37^{abc}	18.83±0.93^{ab}	8.75±0.98^{a}	13.75±1.1^{ab}	13.66±0.81^{ab}	91.58±2.67 ^{abc}
5	17.83±0.752^{bc}	17.75±1.08^{bc}	17.66±1.21^{bc}	8.00±1.09 ^{a}	13.66±0.75^{ab}	13.5±1.50^{ab}	89.25±2.04^{c}
6	16.33±1.751^{d}	17.25±1.60^{c}	16.16±1.60^{d}	7. 33±1.21^{b}	13.16±0.75^{ab}	12.42±0.66^{b}	82.67±6.06 ^{d}
7	18.5±0.41^{bc}	18.66±0.51^{ab}	17.75±0.88b^{c}	9.25±0.67^{a}	13.83±1.75^{ab}	14.33±0.52^{a}	92.50±1.09^{abc}
8	18.08±0.66^{c}	18.33±0.51^{abc}	16.66±1.66^{cd}	9.50±4.38^{a}	13.5±0.54^{ab}	13.41±1.80^{ab}	90.17±4.17^{bc}

Sample (1): Control pan bread, Sample (2): Garlic pan bread, Sample (3): Coriander pan bread, Sample (4): Fennel pan bread, Sample (5): Marjoram pan bread, Sample(6): Sumac pan bread, Sample (7): Cardamom pan bread, Sample (8): Thyme pan bread.

Values are means of three replicates±SD, number in the same column followed by the same letter are not significantly different at 0.05 level.

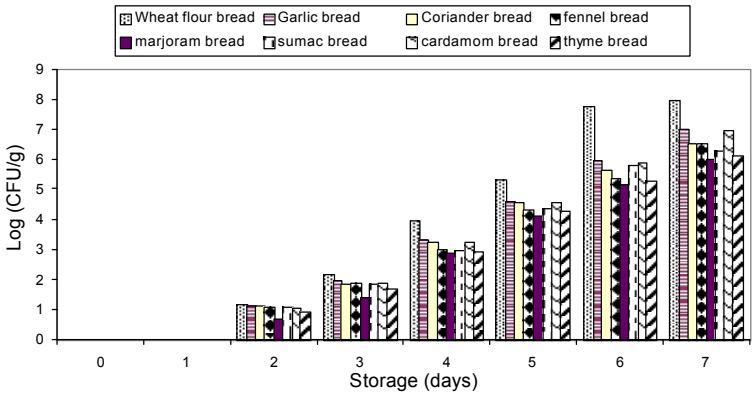

Fig. 4: Log total fungal count of pan bread during storage.

some medicinal and aromatic plants at concentration of 2% on log fungal count in pan bread during storage for 7 days at room temperature. Data showed a gradual increase in log fungal count by increasing storage period (7 days) of all samples. Furthermore, there were observed differences in total fungal count between control and other pan bread samples. Addition of plants under this study decreased log fungal count during storage periods compared with control.

In bakery products, fungi are the most common spoilers. In unpreserved bread, a shelf-life of 3-4 days may be expected especially if the hygiene in the factory is not sufficiently high [41]. Moreover, the shelf life was extended to 5 days in all samples by addition of plants under study, while control sample recorded 4 days only. Results showed that pan bread produced with marjoram had less log fungal count and consequently an increase in shelf life to 5 days. These results are the same trend with the findings of Hafez [42], who suggested that marjoram could be used to extend the shelf life of cakes. Also, similar results were obtained by Basuny *et al.* [39], who reported that the essential oils and phenolic compounds extracted from medicinal herbs are distributed and remained functional as antioxidant and antimicrobial on bakery products. In general terms, essential oils are composed of >70 components, principally polyphenols, terpenes, monoterpenes and seaquiterpenes. These oils have been shown to possess antifungal and antioxidant properties [43].

CONCLUSION

A successful formulation of pan bread with medicinal and aromatic plants performed. Physical attributes of produced pan bread enhanced particularly specific volume and density. Texture analysis showed some improvement in pan bread firmness. Addition of these plants delayed pan bread staling and enhanced odor of samples. Shelf-life of the produced pan bread extended to 5 days during storage time. Generally, some medicinal and aromatic plants could be utilized in improving the physical and sensory characteristics and prolonging the shelf life of pan bread.

REFERENCES

1. Hudaib, M., M. Speroni, A.M. Pietra and V. Cavrini, 2002. GC/MS evaluation of thyme (*Thymus vulgaris* L.) oil composition and variations during the vegetative cycle. J. Pharm. Biomed. Anal., 29: 691-700.
2. Wilson, C.L., J.M. Solar., A. El Ghaouth and M.E. Wisniewski, 1997. Rapid evaluation of plant extracts and essential oils for antifungal activity against *Botrytis cinerea*. Plant Disease, 81: 204-210.
3. Carraminana, J.J., C. Rota, J. Burillo and A. Herrera, 2008. Antibacterial efficiency of Spanish Saturejamontana essential oil against *Listeria monocytogenes* among natural flora in minced pork. J. Food Prot., 71: 502-508.
4. Busatt, C., R.S. Vidal, A.S. Popiolski, A. J. Mossi, C. Dariva, M.R.A. Rodrigues, F.C. Corazza, M.L. Corazza, J.V. Oliveira and R.L. Cansian, 2008. Application of *Origanum majorana* L. essential oil as an antimicrobial agent in sausage. J. Food Microbiol., 25: 207-211.
5. Burt, S., 2004. Essential oils: their antibacterial properties and potential applications in foods-a review. Int. J. Food Microbiol., 94: 223-253.
6. Leeja, L. and J.E. Thoppil, 2007. Antimicrobial activity of methanol extract of *Origanum majorana* L. (*Sweet marjoram*). J. Environ. Biol., 28: 145-6.
7. Handl, S., P. Hellweg, A. Khol-Parisini, B. Rossmann, K. Thurner, W. Luf, J. Novak and J. Zentek, 2008. Effect of oregano (*O. majorana x O. vulgare*) on performance and antioxidative capacity of quails fed a diet rich in omega3 fatty acids. J. Anim. Physiol. Anim. Nutr. (Berl), 92: 242-245.
8. Leela, N.K, D. Prasath and M.N. Venugopal, 2008. Essential oil composition of selected cardamom genotypes at different maturity levels. Indian J. Hort., 65(3): 366-369.
9. Shahwar, M.A., A.H. El-Ghorab, F.M. Anjum, M.S. Butt, S. Hussain and M. Nadeem, 2012. Characterization of coriander (*Coriandrum sativum* L.) seeds and leaves: Volatile and non volatile extracts. Int. J. Food Prop., 15: 736-747.
10. Kossah, R., C. Nsabimana, J. Zhao, H. Chen, F. Tian, H. Zhang and W. Chen, 2009. Comparative study on the chemical composition of Syrian sumac (*Rhus coriaria* L.) and Chinese sumac (*Rhus typhina* L.) fruits. Pak. J. Nutr., 8: 1570-1574.
11. Sajid, M., M.S. Butt, A. Shehzad and S. Tanweer, 2014. Chemical and mineral analysis of garlic: a golden herb. Pak. J. Food Sci., 24(2): 108-110.
12. Aligiannis, N., E. Kalpoutzakis, S. Mitaku and I.B. Chinou, 2001. Composition and antimicrobial activity of the essential oils of two Origanum species. J. Agric. Food Chem., 49: 4168-4170.
13. Baydar, H., O. Sagdic, G. Ozkan and T. Karadogan, 2004. Antibacterial activity and composition of essential oils from *Origanum*, *Thymbra* and *Satureja* species with commercial importance in Turkey. Food Control, 15: 169-172.
14. Piccaglia, R. and M. Marotti, 2001, Characterization of some Italian types of wild fennel (*Foeniculum vulgare* Mill.), J. Agric Food Chem., 49(1): 239-244.
15. Kotsianis, I.S., V. Giannou and C. Tzia, 2002. Production and packaging of bakery products using MAP Technology. Food Sci. Technol., 13: 319-324.

16. Azizi, M.H. and G.V. Rao, 2005. Effect of storage of surfactant gels on bread making quality of wheat flour. Food Chem., 89: 133-138.
17. Corsetti, A., M. Gobetti, F. Balestrieri, L. Russi and J. Rossi, 1998. Sourdough lactic acid bacteria effects on bread firmness and staling. J. Food Sci., 63: 347-351.
18. He, H. and R.C. Hoseney, 1990. Changes in bread firmness and moisture during long-term storage. Cereal Chem., 67: 603-605.
19. AACC, 2002. Approved Methods of the American Association of Cereal Chemistry. Am. Assoc. Cereal Chem. Inc, St. Paul, Minnesota.
20. AOAC, 2005. Official Methods of Analysis of AOAC International 18th Ed. AOAC, Washington.
21. Bourne, M.C., 2003. Food Texture and Viscosity: Concept and Measurement. Elsevier Press, New York/London.
22. Tepe, B., D. Daferera, A. Sokmen, M. Sokme and M. Polissiou, 2005. Antimicrobial and antioxidant activities of the essential oil and various extracts of *Salivia tomentosa* Miller (Lamiaceae). Food Chem., 90: 333-340.
23. Khorshid, A.M., Nadia H.A. Assem, Nadia M. Abd-El-Motaleb and J.S. Fahim, 2011. Utilization of flaxseeds in improving bread quality. Egypt. J. Agric. Res., 89(1): 241-250.
24. Yamazaki, W.T., 1953. An alkaline water retention capacity test for the evaluation of cookie baking potentialities of soft winter wheat flours. Cereal Chem., 30: 242-246.
25. Kitterman, J.S. and G.L. Rubenthaler, 1971. Assessing the quality of early generation wheat selection with the micro AWRC test. Cereal Sci. Today, 16: 313-328.
26. Mislivec, P.B., L.R. Beuchat and M.A. Cousin, 1992. Yeast and Molds. In: Compendium of Methods for the Microbiological Examination of Foods. 3rd Edition, C. Vanderzant and D.F. Splittstoesser (Eds.). American Public Heath Association, Washington, D.C., pp: 239-249.
27. Swanson, K.M.J., F.F. Busta, E.H. Peterson and M.G. Johnson, 1992. Colony count methods. In: Compendium of Methods for the Microbiological Examination of Foods. 3rd edition. C. Vanderzant and D.F. Splittstoesser (Eds). American Public Health Association, Washington, D.C., pp: 75-95.
28. Hamza, B., S.M.M. Zaghloul and B.M. Abd El-Lateef, 2001. Sensory and biological evaluation of pies containing different types of herbs powders. Egypt. J. Nutr., XVI(1): 205-228.
29. Hussein, A.M.S., M.S. Shaheen, H.H. Abdel–Kalek and S.A.H. Abo El–Nor, 2014. Production of low calorie bakery product with pleasant flavour, antioxidant and antimicrobial activities. Pol. J. Food Nutr. Sci., 64(4): 253-265.
30. Šimurina, O., B. Filipèev, D. Psodorov, M. Sakaè and B. Novakoviæ, 2008. Bread supplemented with herbal blend vital plant. Food Processing, Quality and Safety, 35: 113-117.
31. Xie, F., E. Floyd, S. Dowell and X.S. Sun, 2004. Using visible and near-Infrared reflectance spectroscopy and differential scanning colorimetry to study starch, protein and temperature effects on bread staling. Cereal Chem., 81(2): 249-254.
32. Gomez, M., F. Ronda, C.A. Blanco, P.A. Caballero and A. Apesteguia, 2003. Effect of dietary fiber on dough rheology and bread quality. Eur. Food Res. Technol., 216: 51-56.
33. Mehder, A.O.A., 2013. Pomegranate peels effectiveness in improving the nutritional, physical and sensory characteristics of pan bread. Current Sci. Int., 2(2): 8-14.
34. Madsen, H.L. and G. Bertelsen, 1995. Spices as antioxidants. Trends Food Sci. Tech., 6: 271-277.
35. Gramza-michałowska, A., Z. Abramowski, E. Jovel and H. Marzanna, 2008. Antioxidant potential of herbs extracts and impact on HepG2 cells viability. Acta Sci. Pol., Technol. Aliment., 7(4): 61-72.
36. Amro, B., T. Aburjai and S. Al-Khalil, 2002. Antioxidative and radical scavenging effects of olive cake extract. Fitoterapia, 73: 456-61.
37. Craig, J.W., 1999. Health-promoting properties of common herbs. Am. J. Clin. Nutr., 70: 49-55.
38. Das, L., U. Raychaudhuri and R. Chakraborty, 2012. Supplementation of common white bread by coriander leaf powder. Food Sci. and Biotechnol., 21: 425-433.
39. Basuny, A.M., S.L. Nasef, E.A.M. Mahmoud and S.M. Arafat, 2012. Use of medicinal and aromatic plants for increasing quality of some bakery products. Int. Sci. Invest. J., 25: 207-211.
40. Suhr, K.I. and P.V. Nielsen, 2004. Effect of weak acid preservatives on growth of bakery product spoilage fungi at different water activity and pH values. Int. J. Food Microbiol., 95: 67-78.
41. Lund, L.R., J. Rømer, N. Thomasset, H. Solberg, C. Pyke, M.J. Bissell, K. Danø and Z. Werb, 1996. Two distinct phases of apoptosis in mammary gland involution: proteinase-independent and dependent pathways. Development, 122: 181-193.

42. Hafez, A.A., 2012. Physico-chemical and sensory properties of cakes supplemented with different concentration of marjoram. Aust. J. Basic Appl. Sci., 6(13): 463-470.

43. Prabuseenivasan, S., M. Jayaku and S. Ibnacimuthu, 2006. *In vitro* antibacterial activity of some plant essential oils. BMC Complem. Altern. M., 6: 39-47.