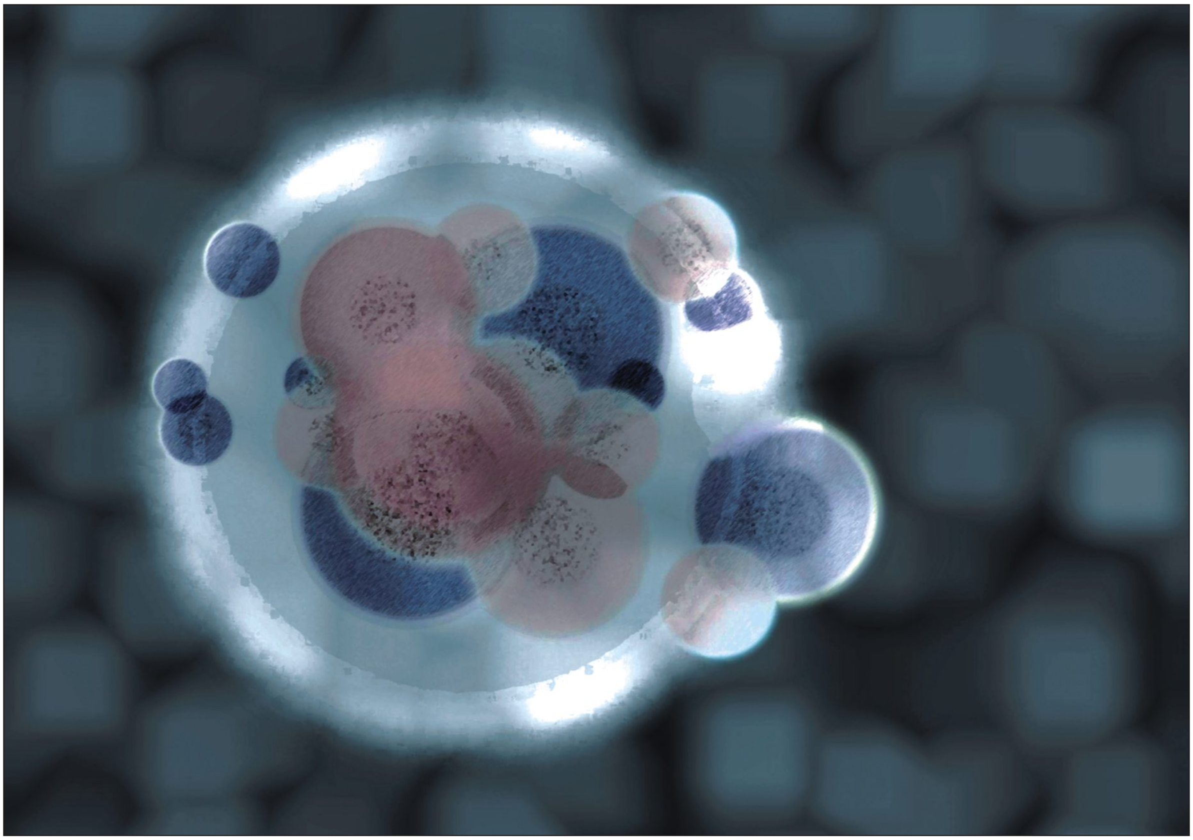

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Research Article
Properties of Probiotic UF-white Soft Cheese Fortified with Garlic Extract

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Abstract
Background and Objective: Garlic ranks highly among health protecting foods, largely due to its antioxidant sulfur compounds. In this study, various properties of UF-white soft cheese fortified with aqueous garlic extract were investigated regarding sensory and microbiological features. **Materials and Methods:** Probiotic UF-white soft cheese fortified with 2 (T_1), 4 (T_2) and 6% (T_3) garlic aqueous extract (GAE, 1:2) was evaluated. Further microbial and chemical analysis with texture profiling, color determination and sensory evaluation was done. **Results:** By increasing the proportion of Aqueous Garlic Extract (AGE) in soft cheese, total solids, fat and protein contents as well as pH value decreased, while tyrosine and tryptophan contents slightly increased. GAE-fortified cheese was higher in lightness and yellowish degrees as well as gumminess and lower in hardness. As storage continues, the lightness of GAE-fortified cheese was more stable, while the hardness increased to an extent that it became $\geq$ the hardness of control cheese. On day 10 on wards, the viable counts of *B. bifidum* in cheese control and T_1 were closed and higher than those of T_2 and T_3. Mould and yeast were not detected in GAE-fortified cheese until the end of storage (90 days), reflecting GAE has an antimicrobial effect against mould and yeast. Cheese fortified with 6% GAE had judging score acceptable but less than the other treatments. **Conclusion:** It can be concluded that fortification with the low concentration of GAE (2%) improved cheese chemical, physical and microbiological properties with novel acceptable flavor.

Key words: Aqueous garlic extract, white soft cheese, probiotic bacteria, physical properties

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Cheese is one of the oldest forms of manufactured foods and it is believed that the history of the cheese industry dates back more than 10000 years BC. White soft cheese accounts for about three-quarters of the cheese made and consumed in Egypt. It is produced by different procedures, i.e., traditional methods and ultra filtration (UF). The UF technology has many advantages in cheese making such as increasing cheese yield and nutritive values, decreasing the production cost and solving the environmental problems related to whey disposal[1,2].

In recent years, herbs and spices are used not only to give food a desirable flavor and color but also are used a medicine for its antimicrobial and antioxidant properties, making it a suitable food preservative[3,4]. Herbs come from aromatic plants grown in the temperate zone, while spices are products of tropical plants. Usually, the leaves of herbs are used, whereas, spices may come from the bark, berries. Among the natural spices, garlic (*Allium sativum*) is a plant in the onion family, grown for its cooking, nutritional and medicinal properties. It is high in a sulfur compound called Allicin, phenolic, flavonoid and terpenoid compounds as well as rich in manganese, vitamin B6, vitamin C, selenium and phosphors[5,6]. Garlic is considered one of the best disease-preventing foods because of its potent and widespread effects[7,8]. Garlic supplementation helps to reduce cold and flu symptoms, high blood pressure (hypertension), total and LDL cholesterol, lead toxicity and protect against cell damage and ageing[9-12]. Also, it may reduce the risk of Alzheimer's disease and dementia[13].

Most herbs can be found dried or fresh and can be used either way with ease. There are many ways to get more garlic into your diet as it is available in whole, powdered, oil form and extract. Some studies have been conducted to supplementation some dairy products with garlic extract[14,15]. The aim of this study was to evaluate the physicochemical, microbiological and sensory properties of UF-white soft cheese fortified with aqueous garlic extract.

MATERIALS AND METHODS

Materials: Milk retentate was obtained from Dairy unit, Animal Production Research Institute, Ministry of Agriculture, Dokki, Giza, Egypt. The average of milk retentate composition was 31.98, 13.05, 14.00 and 4.10% for total solids, protein, fat and ash, respectively. Calf rennet powder (HALA) and starter cultures, *Lactococcus lactis* spp. *lactis* and *Lactococcus lactis* spp. *Cremoris* as well as *Bifidobacterium bifidum* were obtained from Chr. Hansen's Lab., A/S Copenhagen, Denmark. Mature garlic, *Allium sativum* was purchased from local market, Cairo, Egypt.

Methods: This study was conducted in the laboratories of the National Research Center (Giza, Egypt) after the purchase of garlic samples in May, 2017 from the local market.

Preparation of garlic aqueous extract (GAE): Several cloves of mature garlic were peeled from all the papery skin. Cloves of peeled mature garlic were cut into small pieces and mixed well with distilled water (1:2) using home mixer (Philips, HR 7740, Hungary). The mixture was left overnight at 5±2°C and then centrifuged (Sigma Laborzentri Fugen, Germany) at 4000 rpm for 10 min. The clear part (supernatant) was removed and stored at 5±2°C until used.

Starter activation: The *L. lactis* ssp. *lactis* and *L. lactis* ssp. *cremoris* (*Lactococci* count) were activated individually by three successive transfers in sterile 10% re-constituted skim milk powder. *B. bifidum* was activated by three successive transfers in modified MRS, followed by three successive transfers in sterile 10% re-constituted skim milk powder and incubated at 37°C under anaerobic conditions. All strains were obtained from Dairy Microbiological Lab.

Cheese making: Milk retentate was divided into four equal parts. Garlic's aqueous extract (GAE) was added at the rate of 2, 4 and 6% (as the best percentage according to the pre-experimental trails) to create 3 treatments. The latter batch had no GAE, serve as a control. All milk retentate batches were heated to 75°C, cooled to 38°C, inoculated with the starter culture, *L. lactis* spp. *Lactis*, *Lactococcus* spp. *Cremoris* and *B. bifidum* (1:1:1), containing ~ 10^8 CFU mL^{-1} at the rate of 1% and held for 30 min. Salt (3%) was added to milk retentate and an appropriate amount of rennet was added to achieve coagulation in 40 min. Renneting retentate dispensed into plastic bags (500 mL), held at 38°C until a uniform coagulum was formed and storage at 5±2°C. All cheese treatments were kept in a refrigerator at 5±2°C. Chemical, physical and sensory properties of resultant cheese were evaluated during the first 30 days of storage but microbiological changes were evaluated through 90 days of storage. Three replicates have been done.

Microbiological analysis: Cheese samples were microbiologically examined after 0, 10, 20, 30, 45, 60, 75 and 90 days of storage. Twenty-five grams of cheese samples were added aseptically to 225 mL of sterile solution (2% w/v) of sodium citrate diluents and homogenized. The total bacterial count was determined on plate count agar (Oxid) after incubation at 37°C for 48 h for typical colony types and morphological characteristics associated with each culture medium. *L. lactis* ssp. *Lactis* and *L. lactis* ssp. *Cremoris* were enumerated on M17 agar after aerobic incubation[16] at 37°C for 48. *B. bifidum* was determined according to Vinderola and Reinheimer[17] using modified MRS agar supplemented with 0.05% L-cysteine-HCl and the plates were incubated at 37°C for 48 h under anaerobic conditions. Mould and yeast were determined using Potato Dextrose Agar medium and the plates were incubated at 30°C for 5 days[18].

Chemical analysis: Total solids, fat total protein and ash contents of soft cheese samples were determined according to AOAC[19]. The pH value was measured using a digital pH meter (HANNA, Instrument, Portugal) with a glass electrode. The spectrophotometric (Schimadzu spectro-photometer, UV-Vis. 1201, Japan) method of Vakaleris and Price[20] was used for measuring tyrosine and tryptophane contents in cheese samples as an index of proteolysis.

Texture profile of white soft cheese: The Texture Profile Analysis (TPA) of white soft cheese was performed using a multi-test 1-d texture analyzer (mecmesin limited, Slinfold, West Sussex, UK). Experiments were carried out by a compression test that generated a plot of force (N) versus time (sec). Samples were double compressed at a compression speed of 2 cm min^{-1} G. The analysis was carried out at 10 EC. Hardness (g), springiness (mm), gumminess (g) and cohesiveness were calculated from the obtained TPA according to the definition given by the IDF[21].

Color parameters determinations: The color was assessed using spectrocolorimeter (Tristimulus Color Machine) with the CIE lab color scale. This color assessment system is based on the Hunter (Hunter, LabScan XE-Reston VA, USA) L*, a* and b* coordinates. L*, representing lightness to darkness, +a*, redness, -a*, greenness, + b*, yellowness and - b*, blueness in the reflection mode. The instrument was standardized each time with white tile of Hunter Lab Color Standard (LX No.16379):

X = 72.26
Y = 81.94
Z = 88.14
L* = 92.46
a* = -0.86
b* = -0.16[22]

Sensory evaluation: Some expert judges and consumers were selected from a staff member of the Dairy Science Department, National Research Centre, Giza, Egypt to evaluate the texture, flavor and overall acceptability of the cheese samples. They scored the sample on the basis of nine-point hedonic scale, ranging from like extremely = 9 through like or dislike = 5 to dislike extremely = 1 as described by Piggott[23]. Cheese samples were cut into cubes (1.5×1.5×1.5 cm) and covered with plastic wrap to prevent dehydration. The cubes were coded with three-digit random numbers. Cheese samples were held for at least 1 h at 20°C to equilibrate. Each judge was given three cubes of cheese per samples. Water and non-salted crackers were provided to clean their palates between tasting.

Statistical analysis: Statistical analysis was performed using the GLM procedure with SAS[24] software. The two-way independent factorial analysis of variance (ANOVA) and Duncan's multiple comparison procedure were used to compare the means. A probability of $p \leq 0.05$ was used to establish statistical significance.

RESULTS AND DISCUSSION

Cheese composition: The Table 1 showed the chemical composition of fresh white soft cheese fortified with 2 (T_1), 4 (T_2) and 6% (T_3) garlic's aqueous extract (GAE). Total solids, protein and fat contents slightly decrease as the GAE increased. Such observation may be related to the decrease in total solids in the GAE compared to milk retentate. Also, addition GAE caused a slight decrease in pH values of white soft cheese, the decrease was proportional to the additional level. A similar observation was made by Abd El-Aziz *et al.*[25,26] in ginger ethanol extract-fortified soft cheese and white cheese pickled in a brine solution containing ginger extract. Also, Regu *et al.*[27] found that a drop in pH value of Ethiopian cottage cheese treated with 1, 3 or 5% garlic and ginger powder. The decrease of pH in GAE treated cheese may be related to the interaction of organosulfur/phenolic compounds of garlic with milk proteins. However, there was no difference in ash content of UF-white soft containing different levels of GAE.

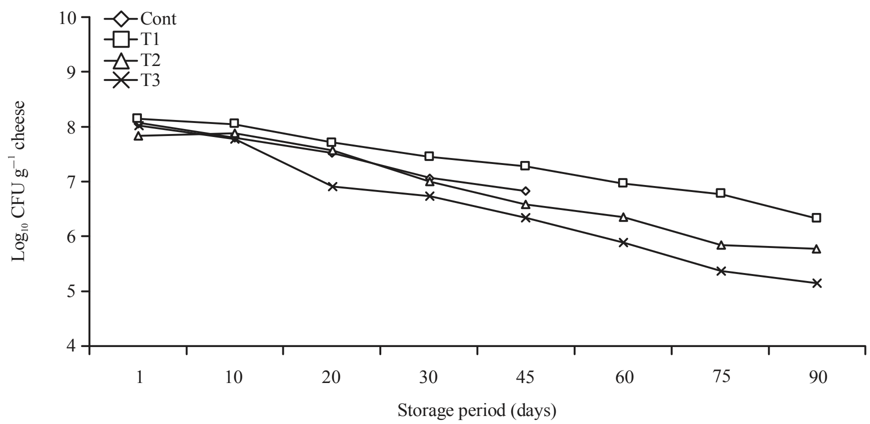

Fig. 1: Viable counts of *Lactococcus* strains in probiotic UF-white soft cheese fortified with garlic aqueous extract at 5±2°C for 90 days

Cont, white soft cheese fortified without GAE, T1: White soft cheese fortified with 2% GAE, T2: White soft cheese fortified with 4% GAE, T3: White soft cheese fortified with 6% GAE

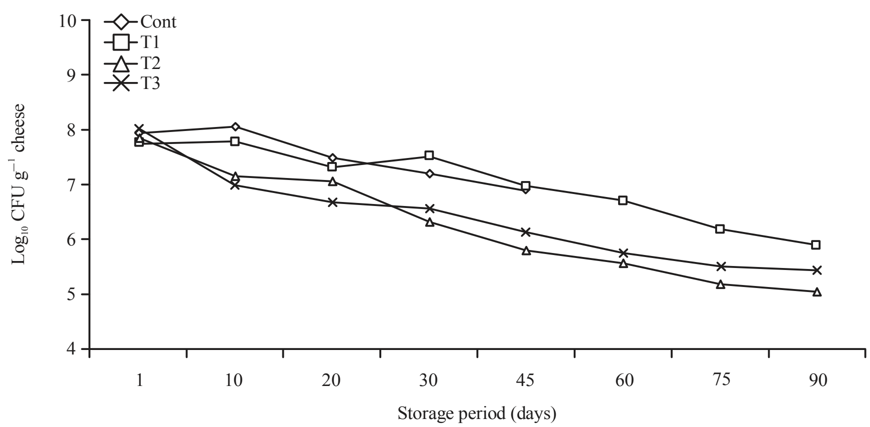

Fig. 2: Viable counts of *B. bacterium* in probiotic UF-white soft cheese fortified with garlic aqueous extract at 5±2°C for 90 days

Cont, white soft cheese fortified without GAE, T1: White soft cheese fortified with 2% GAE, T2: White soft cheese fortified with 4% GAE, T3: White soft cheese fortified with 6% GAE

Table 1: Chemical composition of fresh white soft cheese fortified with garlic aqueous extract

Soft cheese treatments	pH	Total solids (%)	Protein (%)	Fat (%)	Ash (%)
Control	6.60	34.92	12.18	13.35	4.10
T_1	6.53	34.29	11.96	13.11	4.09
T_2	6.35	33.86	11.81	12.91	4.12
T_3	6.30	32.79	11.44	12.53	4.09

T_1: White soft cheese fortified with 2% GAE, T_2: White soft cheese fortified with 4% GAE, T_3: White soft cheese fortified with 6% GAE

Viable counts of organisms: The viable counts of *Lactococcus* strains and *B. bifidum* in UF-white soft cheese at 5±2°C for 90 days are presented in Fig. 1 and 2, respectively. Firstly, the determination of bacterial count in control cheese was stopped after 45 days of storage for the apparent growth of mould and yeast on the surface (1.78 $\log_{10}$ CFU g^{-1}). While there were no signs of spoilage on the surface of GAE-fortified cheese for 90 days, reflecting GAE was a potent inhibitor of molds and yeast growth. Similar, Sagdic *et al.*[15] found the highest inhibition occurred against mould and yeast in the soft cheese brined with garlic or/and thyme extract. Abd El-Aziz *et al.*[25] have reported that mould and yeast were detected only in cheese control sample after 2 weeks, however, they were not observed in ginger extract-fortified cheese throughout the storage period. Regu *et al.*[27] observed that a 3% garlic powder treated KEFIRS showed the lowest

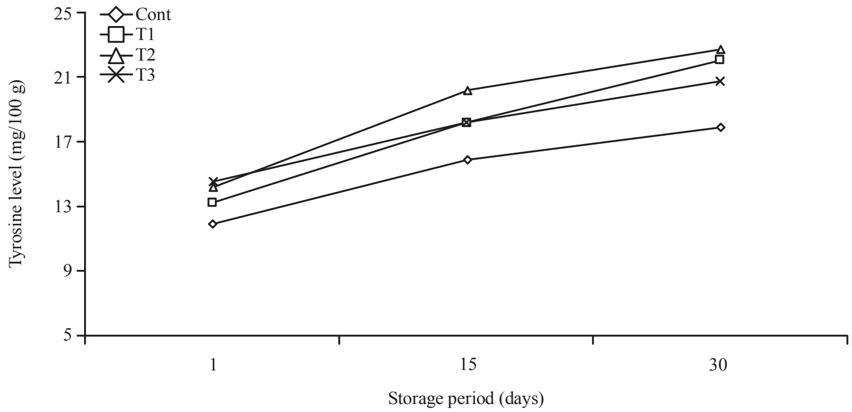

Fig. 3: Tyrosine content in UF-white soft cheese fortified with garlic aqueous extract at 5±2°C for 30 days
Cont, white soft cheese fortified without GAE, T1: White soft cheese fortified with 2% GAE, T2: White soft cheese fortified with 4% GAE, T3: White soft cheese fortified with 6% GAE

yeast and mould (6.32 CFU g^{-1}) and coliform (1.09 CFU g^{-1}) counts. However, there was no significant difference in the counts of *Lactococcus* strains (*L. lactis* spp. *Lactis* and *L. lactis* spp. *Cremoris*) in all UF-white soft cheese until day 10 (p>0.05). The *Lactococcus* strains counts were ranged from 7.85-8.19 $\log_{10}$ CFU g^{-1} and from 7.77-8.03 $\log_{10}$ CFU g^{-1} at day 1 and 10, respectively. A gradual decrease in the viable counts of *Lactococcus* strains was observed until the end of storage, the decreasing rate was lower in T_1 followed by cheese control, T_2 and T_3. The decrease was significant (p<0.0) at day 30 for control cheese and T_1 whereas for T_2 and T_3, the decrease was significant at day 20 and 45 (p<0.05). The decreases in *Lactococcus* strains during storage were found to be similar in aerobic plate count of chicken sausage containing fresh ginger (30 g kg^{-1}) or ginger powder (9 g kg^{-1}) and in white soft cheese containing aqueous mint leaf extract[28,29]. Znamirowska *et al.*[30] have also observed the addition of 1% of freeze-dried wild garlic slowed down the fermentation of kefir.

The viable counts of *B. bifidum* as probiotic bacteria were more affected by the higher concentration of GAE. The viable counts of *B. bifidum* in both cheese control and T_1 were very close and higher than those of T_2 and T_3 from day 10 onwards. Over storage period, the viable counts of *B. bifidum* were more stable until day 10 and declined thereafter, the difference being significant only at day 45 (p<0.05). In T_2 and T_3, a significant decrease in the viable counts of *B. bifidum* was observed from day 10 onwards (p<0.05). These results reflected the low concentration of GAE may have a positive effect on the survival of both starter and probiotic bacteria during the cold storage. Shori and Baba[14], have reported that the viability of *Lactobacillus* spp. in cow milk yoghurt, made with low concentration of GAE was not significantly different throughout the 21 days of refrigerated storage.

Cheese proteolysis: Changes in proteolysis of white soft cheese fortified with GAE during cold storage period for 30 days as measured by tyrosine and tryptophan contents, were illustrated in Fig. 3 and 4. GAE-fortified cheese caused a slight increase in tyrosine and tryptophan contents at day 1 (p>0.05). Thereafter, the extent of proteolysis (tyrosine content) was higher in cheese fortified with GAE than in control cheese, the difference being significant (p<0.05) at day 15 for T_2 and day 30 for T_1 and T_3. A similar but less market, the increase was observed in tryptophan content, the increase was significant only at day 15 for T_2 and T_3. During storage period, a gradual increase in both tyrosine and tryptophan contents with the time increased, the rate of increasing was more pronounced in T_2. Shori and Baba[31] have also observed an increase in proteolytic activity of yogurt made from camel or cow milk fortified with *Allium sativum* and *Cinnamomum verum* aqueous extract. However, this result differs from that found in surimi gel containing garlic extract during cold storage[32].

Texture attributes: Texture attributes of GAE-fortified soft cheese at 4±2°C for 30 days are presented in Table 2. On day 1, cheese hardness slightly decreased along with the increase of the GAE concentrations (p>0.05). Cheese hardness decreased from 2.25 (N) in control cheese to 2.0, 1.7 and 1.7 (N) in T_1, T_2 and T_3, respectively. The decrease in cheese

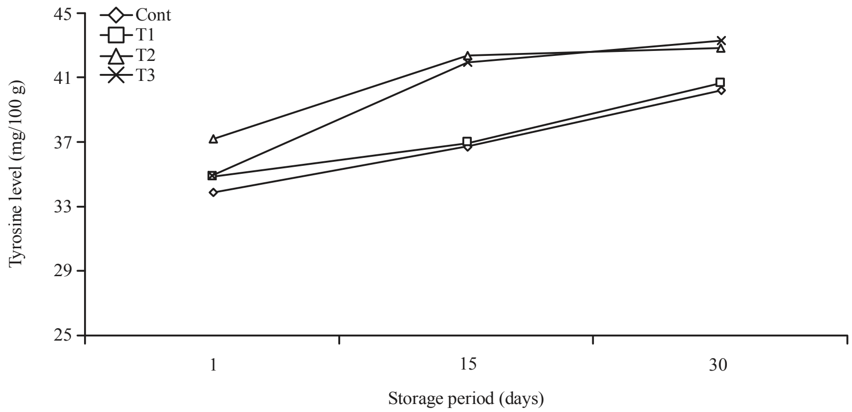

Fig. 4: Tryptophane content in UF-white soft cheese fortified with garlic aqueous extract at 5±2°C for 30 days

Cont, white soft cheese fortified without GAE, T1: White soft cheese fortified with 2% GAE, T2: White soft cheese fortified with 4% GAE, T3: White soft cheese fortified with 6% GAE

Table 2: Texture attributes of UF-white soft cheese fortified with garlic aqueous extract at 5±2°C for 30 days

Items	Storage period (days)	Cheese treatments Control	T_1	T_2	T_3
Hardness (N)	1	2.25±0.10^{Ac}	2.00±0.10^{Ac}	1.70±0.07^{Ac}	1.70±0.10^{Ac}
	15	3.55±0.35^{Ab}	3.40±0.20^{Ab}	4.30±0.20^{Ab}	3.85±0.65^{Ab}
	30	6.25±0.35^{Aa}	5.90±0.20^{Aa}	6.65±0.35^{Aa}	5.70±0.60^{Aa}
Cohesiveness B/A	1	0.52±0.01^{Ab}	0.52±0.01^{Ab}	0.53±0.01^{Ab}	0.52±0.04^{Ab}
	15	0.73±0.02^{Aa}	0.74±0.00^{Aa}	0.71±0.00^{Aa}	0.72±0.04^{Aa}
	30	0.72±0.00^{Aa}	0.72±0.02^{Aa}	0.66±0.02^{Aa}	0.70±0.02^{Aa}
Springiness (mm)	1	0.67±0.04^{Ab}	0.67±0.00^{Ab}	0.69±0.00^{Aa}	0.69±0.02^{Aa}
	15	0.87±0.02^{Aa}	0.82±0.03^{Aa}	0.81±0.04^{Aa}	0.79±0.06^{Aa}
	30	0.83±0.07^{Aa}	0.87±0.09^{Aa}	0.75±0.02^{Aa}	0.74±0.09^{Aa}
Gumminess	1	1.17±0.05^{Ac}	1.03±0.01^{Ab}	0.90±0.02^{Ab}	0.90±0.12^{Ab}
	15	3.29±0.23^{Aa}	3.25±0.87^{Aa}	3.35±0.12^{Aa}	3.00±0.62^{Aa}
	30	4.39±0.009^{Aa}	4.21±0.14^{Aa}	3.85±0.37^{Aa}	3.58±0.53^{Aa}

Means with the same capital letters in the same row and the same small letters in the same column are not significantly different ($p \leq 0.05$), T_1: White soft cheese fortified with 2% GAE, T_2: White soft cheese fortified with 4% GAE, T_3: White soft cheese fortified with 6% GAE

hardness may be correlated with the decrease in cheese total solids contents (Table 1). A similar but less marked, cheese gumminess decrease with the GAE concentrations increased (p>0.05). However, fortification with GAE had no significant effect on cheese cohesiveness and springiness compared with control cheese (p>0.05). During storage period, cheese hardness, cohesiveness, springiness and gumminess increased along with the time increased (p<0.05), the increasing rate was more pronounced in cheese hardness and cheese gumminess. A similar observation was found by Abd El-Aziz *et al.*[25] in white soft cheese fortified with ethanol ginger extract. Creamer and Olson[33] reported that when proteolysis occurs, ionic peptides created, thus, competition for available water increases and less water is available to solvate protein chains and the resulting cheese is harder and less deformed. Also, there was a negative correlation between cheese pH and cheese hardness, the cheese pH affects the texture of curd directly by influencing the solubility of the caseins[34]. In addition, Majumdar *et al.*[32] found that GAE increase water holding capacity, which indicated stronger protein network formation and increase the gel strength of surimi gel during cold storage.

Color parameters: Cheese colors consider as important factor for consumer acceptance. On day 1, lightness (L*), redness (a*) and yellowish (b*) degrees of soft cheese fortified with GAE were higher than those of control cheese (Table 3). The increase in rednesh and yellowish degrees was also observed in white cheese pickled in a brine solution containing ginger extract[26]. The lightness degree of cheese fortified with GAE was also higher than that of control cheese until the end of the storage period (30 days). The increase in yellow degree of fortified cheese may be attributed to sunset yellow color of

Table 3: Color parameters of white soft cheese fortified with EGE at 4±2°C for 30 days

Items	Storage period (days)	Cheese treatments Control	T_1	T_2	T_3
L*	1	92.61	93.38	94.32	94.52
	15	92.11	93.54	93.57	93.28
	30	90.73	93.09	93.52	94.54
a*	1	- 1.79	-1.01	-1.23	-0.89
	15	- 1.06	-1.01	-0.81	-0.60
	30	0.75	-0.56	-0.45	1.07
b*	1	18.50	19.73	20.85	20.85
	15	20.89	20.76	21.03	20.88
	30	22.74	21.74	21.03	23.05

T_1: White soft cheese fortified with 2% GAE, T_2: White soft cheese fortified with 4% GAE, T_3: White soft cheese fortified with 6% GAE, L: Darkness from black (0) to white (100), a: Colour red (+) to green (-), b: Colour yellow (+) to blue (-)

Table 4: Sensory evaluation of UF-white soft cheese fortified with garlic aqueous extract at 5±2°C for 30 days

Items	Storage period (days)	Cheese treatments Control	T_1	T_2	T_3
Appearance	1	8.3 ± 0.19^{Aa}	8.0 ± 0.89^{Aa}	8.2 ± 0.75^{Aa}	7.9 ± 1.17^{Aa}
	15	7.8 ± 0.26^{Aa}	7.5 ± 0.76^{ABa}	7.4 ± 0.92^{Aa}	7.5 ± 0.76^{Aa}
	30	6.7 ± 0.52^{Bb}	7.0 ± 1.09^{Bab}	7.7 ± 0.82^{Aa}	7.7 ± 0.82^{Aa}
Body and texture	1	8.2 ± 0.25^{Aa}	8.0 ± 0.89^{Aa}	8.2 ± 0.75^{Aa}	7.7 ± 0.017^{Aa}
	15	7.5 ± 0.75^{ABa}	7.3 ± 0.89^{Aa}	7.2 ± 0.83^{Ba}	7.2 ± 1.07^{Aa}
	30	7.0 ± 0.63^{Ba}	7.5 ± 0.55^{Aa}	7.50 ± 0.55^{ABa}	7.3 ± 0.52^{Aa}
Flavor	1	7.8 ± 0.26^{Aa}	7.6 ± 0.82^{Aa}	7.8 ± 0.98^{Aa}	6.8 ± 0.98^{Aa}
	15	7.3 ± 0.87^{Aa}	7.3 ± 1.39^{Aa}	6.8 ± 1.39^{Aa}	6.5 ± 1.51^{Aa}
	30	6.7 ± 0.52^{Aa}	7.1 ± 1.32^{Aa}	7.0 ± 1.44^{Aa}	6.2 ± 0.93^{Aa}

Means (±SE, n = 3) with the same capital letters in the same row and the same small letters in the same column are not significantly different at $p\leq0.05$, T_1: White soft cheese fortified with 2% GAE, T_2: White soft cheese fortified with 4% GAE, T_3: White soft cheese fortified with 6% GAE

GAE. The lightness degree of cheese fortified with GAE did not affected by storage time whereas control cheese showed continued decrease in lightness degree. These results may be related with the formation of compounds following lipid oxidation which was more in control cheese and lower in fortified cheese[32]. However, cheese redness and yellowish increased as the time of storage increased. Znamirowska *et al.*[30] observed that the addition of 1% of freeze-dried wild garlic powder caused an increase in yellowish and decrease in whiteness color degree of Kefir made from sheep's milk.

Sensory evaluation: Sensory attributes, including appearance, body and texture and flavor of different UF-soft cheese treatments, indicated that the score of appearance was not clearly affected by the ratio of GAE fortification but flavor and body and texture were more affected (Table 4). Panelists gave higher scores to T_1 and T_2, which had a firm body and smooth texture with acceptable flavor than T_3. The lower acceptability of T_3 could be due to the strong pungent taste of garlic[35]. As storage periods increased, the sensory attributes of UF-soft cheese slightly decreased (p>0.05). In contrast to this result, Vafopoulou *et al.*[36] reported that proteolysis products and free fatty acids produced during storage imparted the characteristic flavor of feta cheese.

CONCLUSION

Aqueous garlic extract can be used in the manufacture of UF-soft cheese to improve its physicochemical properties and keeping quality with a novel flavor. Also, the low concentration of GAE (2%) may have a positive effect on the survival of both starter culture and probiotic bacteria of soft cheese during storage compared with the high concentrations (2 and 4% AGE). Thus, garlic can be beneficial in the production of healthy soft cheese rich in the natural antioxidants and is compatible with Egyptian people who prefer the pungent taste.

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