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Research Article

Effects of Adding Garlic Extract on Extending Shelf Life of Home-made Yogurt

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Abstract

This cross-sectional experimental study was conducted in 2021 at Almaseed Locality, Gazeera State, Sudan to determine the effect of addition of garlic extract to extend the shelf life of home-made yoghurt without affecting the organoleptic quality of yoghurt. Milk and garlic were obtained from the local market at Almaseed Locality. Starter culture was obtained from newly home- made yoghurt. The garlic extract was prepared by soaking 40g of raw garlic in 200ml of hot distilled water (70-100 °C) for four hours with continuous stirring, then cooled, filtered and dried by water path at 60 °C to a powder form. 75% solution of the garlic extract was prepared, from which different doses (0.3, 0.4 and 0.5µl) were taken and added to10ml of newly prepared home-made yoghurt to immediately determine the most acceptable dose without affecting sensory attributes (color, flavor, taste and texture). Then selected dose was added to 10ml of newly prepared home-made yoghurt and stored at room temperature along with control sample to evaluate the total viable bacterial count and pH during the storage periods of the next day of preparation of yoghurt (at zero time, after 4hr, 8hr, 12hr, 18hr and 24hr). 0.3µl dose of garlic extract was found to be the most acceptable dose that was capable of extending the shelf-life of home-made yoghurt to more than one day without affecting the organoleptic qualities. The sensory evaluation showed that the average scores of color (3.4), flavor (3.6) and texture (3.2) were reported as good while the taste (4.4) was reported as very good in garlic treated sample. Generally, the total viable count was less in the sample treated with 0.3µl of garlic extract compared to control sample throughout all storage periods (after 4hrs, 8hrs, 12hrs, 18hrs, and 24hrs) although both control and garlic treated samples had almost the same viable count at zero time ($1.43x10^4$ CFU/ml for control and $1.39x10^4$ (CFU/ml) for treated sample. The number of viable count for treated samples after 18hrs and 24hrs was $1.50x10^4$ CFU /ml and 1.73 $x10^4$ CFU /ml, respectively, whereas control sample was found uncountable at the same periods. The pH was found constant to some extent (5.4 up to 5.0), even after 24hrs of incubation period in garlic extract treated samples and decreased throughout all the storage periods from 5.6 to 4.0 in control sample. The study concluded that 0.3µl of garlic extract, was the most affective dose that capable of extending the shelf-life of home-made yoghurt to more than one day after preparation without affecting the sensory attributes. Therefore, garlic extract can be used to prolong the shelf life of home-made yoghurt for more than one day.

Keywords: *Garlic extract; Shelf-life; Home-made yoghurt; Total Viable Count.*

INTRODUCTION

Codex Alimentarus standards for fermented milk (2013) defined yoghurt as a food produced by culturing one or more optional dairy ingredients with a characteristic bacterial culture that contains the lactic acid-producing bacteria, *Lactobacillus delbrueckii Sub-sp. bugaricus and Sterptococcus thermophilus*. Panagiotis and Constatnina (2014) described yoghurt as a product made from milk, either with or without the inclusion of a natural milk derivative, such skim milk powder or whey. Due to its numerous nutritional advantages, including proteins, lactose, minerals, and water-

and fat-soluble vitamins, milk and milk products play a significant part in the human diet (Tona and Outsole, 2014; Ozturkoglu-Budak, et al., 2016).

Because of these qualities, milk is a necessary component of the human diet, especially for young children and the elderly. Therefore, it is indisputable that milk and its derivatives are essential to a balanced and healthful diet for human growth and development. One of the most popular dairy products is yoghurt, which comes in liquid, solid, and smooth textures. Its sensory qualities greatly influence customer acceptance (Saint-Eve et al., 2006), and it is typically manufactured from the spontaneous or induced lactic acid fermentation of milk (Widyastuti et al., 2014).

Increasing production of home-made yoghurt especially during the high production period of milk where prices are low will help families to obtain home- made yoghurt at lower prices. The shelf life of industrial yoghurt is very limited; maximum 10 days according to Sudanese Standard and Metrology Organization (SSMO, 2007). This period may not be enough to distribute the yoghurt in little far places. Therefore, such places depend on home-made yoghurt where the shelf life is limited to one day.

By adding garlic extract, the current study sought to increase home-made yoghurt shelf life to more than a day without compromising its organoleptic quality.

MATERIALS AND METHODS

This cross-sectional experimental study was conducted in 2021 to determine the effect of addition of garlic extract to extend the shelf life of home-made yoghurt without affecting the organoleptic quality of yoghurt.

- **Materials:** Milk and Garlic were obtained from the local market at Almaseed locality. Starter culture was obtained from newly pervious home- made yoghurt.
- **Methods:** Sterilization of glassware:

Test tubes were washed thoroughly, left to dry and sterilized in a hot air oven at 1600C for at least 1hr as described by Harrigan and McCance (2001). Instruments such as loops, needles, forceps, spoons and knives were sterilized by flaming directly after dipping in spirit.

- **Preparation of Nutrient agar:**
  The nutrient agar media was used for cultivation of bacteria. Twenty- eight grams of dehydrated nutrient agar were suspended in one liter of distilled water, steamed to dissolve completely, the pH was adjusted to 7.4, then the medium was sterilized by autoclaving at 121 °C for 15 minutes as described by Harrigan and McCance (2001).
- **Preparation of aqueous garlic extract:**
  Aqueous garlic extract was prepared according to the method described by Sukhdev *et al*., (2008). 40g of garlic was soaked in 200ml hot distilled water (70-100 °C) for about four hours with continuous stirring. After cooling, the extract was filtered by filter paper (15mm). Then the extract was dried to a powder form by using a water path at 60 °C. 75% solution of the garlic extract was prepared from which the different doses (0.3, 0.4 and 0.5µl) were taken.
- **Preparation of yoghurt:**
  The most widely used method for preparation of home-made yoghurt by women in Almaseed village was followed in this study. Cow milk was boiled for 10 min and cooled to 37 °C. Starter culture was added and then incubated for 4hrs at room temperature.
- **Determination of suitable dose of garlic extract by sensory evaluation:**
  Different doses (0.3, 0.4 and 0.5µl) of garlic extract were added to 10ml of already prepared home-made yoghurt and mixed thoroughly. Then the most suitable dose which didn't affect yoghurt characteristic (color, flavor, taste and texture) was chosen according to sensory evaluation carried by ten untrained households' women from Almaseed locality. The hedonic scale of 5 points (5 extremely like and 1 extremely dislike) as described by Cross *et al.,* (1978) was used as follows:
  5 as excellent; 4 to less than 5 as very good; 3 to less than 4 as good; 2 to less than 3 as acceptable and less than 2 is unacceptable.
  The total points given by the panelists for each sensory factor were tabulated and the average was calculated as shown in Table (1), and represented in form of description as excellent; very good; good; acceptable and un acceptable.
- **Microbial analysis:**
  Total viable bacterial count was carried out by using the standard plate count method as described by Harrigan and McCance (2001). From 250 ml home-made yoghurt 10 ml was taken and treated with the suitable dose of garlic extract; this represented the first dilution. Then 1ml was taken and added to 9ml normal saline to prepare the second dilution. The same procedure was carried out to the control (home-made yoghurt not treated with garlic extract). Then from each sample 1ml from the second dilution was taken into sterile Petri dishes contained 10-15 ml of nutrient agar media after cooled to 45˚C. The inoculums were mixed with the medium and allowed to solidify. The

plates were then incubated at 37 °C. Then after 0hr 4hr, 8hr, 12hr, 18hr and 24hr, the total viable bacterial count was calculated by colony counter (Quebec colony Counter and Hand Tally).

- **Chemical analysis:**
  The pH of home-made yoghurt treated with the suitable dose of garlic extract and the control (home-made yoghurt not treated with garlic extract) was measured during all the storage periods (after 0hr 4hr, 8hr, 12hr, 18hr and 24hr) using a bench-top pH-meter which was previously calibrated with pH 7.0 and 4.0 standard buffers.
- **Statistical analysis:**
  The data were analyzed manually and presented in the form of tables.

RESULTS

As shown in Table (1) different trials were done by the addition of different amounts (0.3, 0.4 and 0.5µl) of garlic extract to one- day already prepared home-made yoghurt to determine the suitable amount of garlic extract which do not affect the organoleptic qualities (color, flavor, taste and texture) of home-made yoghurt. It was found that 0.3µl was the most suitable amount according to the sensory evaluation test. The average scores for color (3.4), flavor (3.6) and texture (3.2) were reported as good while the taste (4.4) was reported as very good in garlic treated sample.

Table 1: Sensory evaluation after the addition of 0.3, 0.4 and 0.5µl of garlic extract to home-made yoghurt.

Doses of garlic extract in home- made yogurt	Types of organoleptic quality	NO. of Panelists										Total of score	Average of score	Overall description of acceptability
		1	2	3	4	5	6	7	8	9	10			
0.3µl	Color score	3	4	3	3	3	5	3	4	3	3	34	3.4	Good
	Flavor score	4	4	4	3	3	4	4	3	3	4	36	3.6	Good
	Taste score	5	3	4	5	5	5	3	5	4	5	44	4.4	Very good
	Texture score	3	3	3	3	3	4	3	4	3	3	32	3.2	Good
0.4µl	Color score	2	1	1	1	3	2	1	1	3	2	17	1.7	Unacceptable
	Flavor score	2	3	1	4	4	2	1	1	3	1	22	2.2	Acceptable
	Taste score	5	4	5	4	3	2	2	3	1	4	33	3.3	Good
	Texture score	1	2	2	1	3	2	3	4	2	1	21	2.1	Acceptable
0.5µl	Color score	2	1	3	2	3	1	2	1	1	1	17	1.7	Unacceptable
	Flavor score	3	1	1	1	1	2	1	2	3	1	16	1.6	Unacceptable
	Taste score	4	3	1	1	2	3	1	1	2	3	21	2.1	Acceptable
	Texture score	1	1	2	3	1	1	2	2	1	1	15	1.5	Unacceptable

Table 2 showed that, at the addition of 0.3µl garlic extract after one day (24hrs) of prepared home-made yoghurt sample, the total viable bacterial count was less when compared with the control sample throughout all incubation periods of the next day (as follows: after 4hr, 8hr, 12hr, 18hr and 24hr) although both samples more or less had the same viable count at zero time of the next day (1.43 x104 CFU/ml for control and 1.39 x104 CFU/ml for treated samples). The number of total viable bacterial count increased progressively (being uncountable) after 18hrs and 24hrs in the control sample. Whereas, treated sample at the same incubation period was 1.50 x104 CFU/ml and 1.73 x104 CFU/ml, respectively.

Table 2: Effect of 0.3µl of garlic extract on the total viable bacterial count (CFU/ml) in home-made yoghurt during the incubation periods at the next day.

Time (hrs.)	CFU/ml in control samples	CFU/ml in treated samples
Zero	1.43x104	1.39 x10^4
After 4hrs	2.86 x104	1.56 x10^4
After 8hrs	5.75 x104	1.50 x10^4
After 12hrs	17.18 x104	1.55 x10^4
After 18hrs	Uncountable	1.50 x10^4
After 24hrs	Uncountable	1.73 x10^4

Table (3) revealed that the pH was decreased throughout the incubation periods from 5.6 up to 4.0 in control sample. This decrease in pH can be attributed to the activity of the lactic acid bacteria which produced lactic acid. While it had been constant (5.4 up to 5.0) to some extent, even after 24hrs of incubation period in samples treated with garlic extract. This indicates that lactobacillus (lactic acid) activity was completely inactivated by the addition of garlic extract, even after 24hrs of the storage.

Table 3: Effect of 0.3µl of garlic extract on the pH of home- made yoghurt during the incubation periods at the next day

Times in Hrs.	pH of the control sample	pH of the treated sample
Zero time	5.6	5.4
After 4hrs	5.3	5.1
After 8hrs	5.0	5.1
After 12hrs	4.6	5.1
After 18hrs	4.2	5.0
After 24h	4.0	5.0

DISCUSSION

The objective of this study was to determine the effect of addition of garlic extract to extend the shelf life of home-made yoghurt without affecting the organoleptic quality of yoghurt.

Generally, additives which prolong the shelf-life span of foods and drinks by preventing micro-organisms attack, are called preservatives (Ferizer, 1989). They prevent the food to which it is added from fermentation and spoilage without causing any harmful effect to the person who consumes the food. So, by adding garlic extract, the current study sought to increase home-made yoghurt shelf life to more than a day without compromising its organoleptic quality.

It was observed from the results that the addition of garlic extract at a 0.3µl dose has a tremendous effect; it decreased the total viable bacterial count and fixed the stability of the pH during the different incubation periods of the next day, which in turn increased the shelf life of the homemade yogurt for more than one day.

This agreed with the results obtained by Metwalli, (2011) who found that the total viable bacterial count as well as yeast and mould decreased during storage period in all kareish cheese treated with garlic extract. Also, the result agreed with Ahmed, *et al.,* (2019), who found that a mixture of garlic and ginger extract GGE extended the shelf life of fish for 8 weeks at 4 °C storage temperature. So, garlic juice may function well as natural preservative in food system due to its antimicrobial activity (Kim, *et al*., 2003).

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- **Competing Interest**

The authors declare that they have no competing interests.

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- **Authors' contributions**

This work was carried out in collaboration between authors. Author (1) collected the research data, conducted laboratory analysis, and performed statistical analysis. Author (2) conceptualized the initial idea and performed supervision over the research. Author (3) prepared, edited and reviewed the final manuscript and carried out correspondence duties. Author (4) co-supervised the study and contributed to drafting the initial manuscript.

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