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Preservative Effects of Jordanian Sage-oil on Storage Stability of Tamarind Beverage

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Abstract The effect of Jordanian sage-oil on the quality attributes of tamarind beverage during storage was investigated. Tamarind beverages were produced with or without sage-oil (100 mg sage-oil). Tamarind beverage produced according to traditional processing method served as the control. The tamarind beverages were stored for 4 months at room (29 ± 2°C) and refrigerated (4–10°C) temperatures. Samples were analyzed, at regular intervals, for chemical, sensory, and microbiological qualities. Appearance of coliforms or overall acceptability score of 5.9 was used as deterioration index. The control beverages deteriorated by 2nd and 10th days at room and refrigerated temperatures, respectively. Tamarind beverage produced without the inclusion of sage-oil was stable for 3 and 5 weeks at room and refrigerated temperatures, respectively. Sage-oil extended the shelf life of the tamarind beverage to 6 - 13 weeks, respectively.

Keywords Preservatives, Sage-Oil, Storage, Stability, Tamarind-beverage, Sensory, Microbial Qualities

1. Introduction

One of today's challenges for the food industry is to guarantee safe foods throughout the supply chain, whilst retaining the same properties that were present when the foods were freshly made. During the distribution channel, from food manufacturer to consumer, food products need to be protected against physical, chemical and microbial deterioration.[1] This paper focuses on the prevention of food spoilage, caused by the activity of micro-organisms.[2] Sage oil possesses some excellent medicinal properties that are highly beneficial for health.[3] Given in this Buzzle article are the benefits of using this essential oil.[3] Sage oil fights different forms of infections caused by fungus, bacteria, and virus.[3] It is used for treating various fungal infections that affect our skin and nails, by not only curing these infections, but also preventing the spread and growth of fungus to any other part of the body. Natural preservatives like oil-sage have been used since ages to preserve food stuffs.[4] Sugars are generally used to preserve fruits or to make jams. While sage-oil is added to dried meats, vegetables, and beverages to preserve them for longer. [5] Sage and sugar act as excellent natural preservatives, as they prevent the bacterial growth through the process of osmosis. Preservatives like sage-oil works as an excellent antioxidant, and prevent the oxidation of foods.

Tamarind (*Tamarindus indica* L.), a tropical fruit found in Africa and Asia, is highly valued for its pulp [6]. Tamarind fruit pulp has a sweet acidic taste due to a combination of high contents of tartaric acid and reducing sugars [7] .The pulp is used for seasoning, in prepared foods, to flavor confections, curries, and sauces, and as a major ingredient in juices and other beverages [7].

This study therefore aimed at investigating the effects of sage-oil on the chemical, sensory, and microbial attributes during storage of tamarind beverage produced by the traditional method.

2. Material and Methods

2.1. Materials

Mature tamarind fruits and granulated sugars were procured from a local market in Amman. All the chemicals used were produced by Merk

2.2. Production of Tamarind Beverages

Tamarind beverage was prepared according to the traditional method .Tamarind pulp was manually separated from shells, seeds, and other foreign materials. About 1 g of tamarind pulp was mixed with 750 ml of water. Sugar (27.5 g) was added. The mixture was sieved with fourfold layer muslin cloth. The beverage was packaged in sterilized glass bottles, corked, and pasteurized at 95°C for 8 min. Furthermore, a pilot study was carried out in which the beverage was mixed with various concentrations of sage-oil (50–150 mg/100 ml). Paired preference test was used to determine the acceptable concentration of sage-oil, which was found to be 100 mg/100 ml.

2.3. Storage

Tamarind beverages were stored at room (28 ± 2°C) and refrigerated (4–10°C) temperatures for 4 months. The beverage was assumed stable until the appearance of coliform or when the overall acceptance score was less than 5.9

2.4. Sensory Evaluation

Tamarind beverages were evaluated by self evaluation at Chemistry Department at ASU using a 9-point hedonic scale, where 1 = *dislike extremely*, 5 = *neither like nor dislike*, and 9 = *like extremely*.

3. Chemical Analyses

The pH, total acidity, soluble solids, and total solids of tamarind beverages were determined according to A.O.A.C. [8], ascorbic acid according to A.A.C.C [9] color by measuring absorbance at 325 nm [10], total solids according to Adeyemi and Umar [11], browning index according to Johnson et al. [12], and cloudiness according to Khurdiya and Verma [13].

3.1. Microbiological Analyses

Samples were serially diluted in one-fourth strength Ringer's solution. Aliquots were further diluted to obtain 10^{-1} to 10^{-4} for microbial counts. About 1.0 ml was transferred aseptically to Petri dishes, poured with plate count agar (PCA) for total viable counts, McConkey agar (MCC) for coliform counts, and acidified potato dextrose agar (PDA) for total molds and yeasts counts. PCA and MCC were incubated at 35°C for 48 h while PDA was incubated at 25°C for 3–5 days.

3.2. Statistical Analyses

Data obtained from chemical analyses were averaged and standard deviation calculated. Microbial counts were converted to $\log_{10}$ CFU/ml. One-way analysis of variance (ANOVA) was used for the analysis of the microbial logarithmic values and hedonic scores. Duncan's multiple range tests and least significant difference (LSD) were, respectively, used to separate means that were significantly different ($P < 0.05$) for microbial logarithmic values and hedonic scores.

4. Result and Discussions

4.1. Chemical Properties

Table (1) shows the changes in the physical and chemical attributes during storage of tamarind beverages prepared by the traditional processing method. The beverage had a shelf life of 1 and 8 days at room and refrigerated temperatures, respectively. There were distinct changes in the chemical attributes of the beverage during storage at both temperatures, although the changes were less pronounced at refrigerated temperature. However, there was no significant change in the total acidity of the beverage up to 2 and 4 days of storage at room and refrigerated temperatures, respectively, while the pH changed significantly during the period [14],and the pH and acidity are not always inversely related.

Table 1. Physical and chemical attributes during storage of tamarinds beverage produced by traditional processing method

Storage Temperature	Period of storage (days)	Quality attributes									
		Color A_{325nm}	Total Solid g/100ml	Total Soluble solid (˚Brix)	pH	Total acidity (%)	Cloudiness (A_{660nm})	Browning Index (A_{420nm})	Total Sugar (%)	Ascorbic acid (%)	Ash (%)
Room Refrigerated	0	0.91	21.0	18.5	3.0	1.0	0.68	1.43	18.0	9.4	0.43
	0	0.91	21.0	18.5	3.0	1.0	0.68	1.43	18	9.5	0.43
	2	0.95	16.3	14.0	2.8	1.0	0.65	1.50	13.5	7.3	0.37
	4	0.96	13.0	11.0	2.5	1.0	0.62	1.51	11.2	6.2	0.30
	6	0.98	11.1	9.0	2.0	1.1	0.56	1.56	8.6	5.6	0.30
	8	0.99	9.5	8.0	2.0	1.1	0.45	1.63	7.4	5.2	0.20

4.2. Microbial Load

Table 2 shows the antimicrobial effect of sage oil, sage itself is active against many microorganisms, and significant effects were shown on *Staphylococcus aureus*.

Table 3 shows the microbial load during storage of spiced tamarind beverage produced by traditional processing method. The total plate and total molds and yeasts counts of the beverage were 3.98 log CFU/ml and 4.58 log CFU/ml at room temperature, respectively, and 3.98–5.25 log CFU/ml and 4.58–5.67 log CFU/ml, respectively, at refrigerated temperature. No coliform bacteria were observed in the beverage until days 2 and 10 during storage at room and refrigerated temperatures, respectively. Onuorah et al. (15) reported a microbial load of 1.5×10^3 to 6.9×10^7 CFU/ml and 1.5×10^3 to 6.6×10^6 CFU/ml for traditionally manufactured tamarind beverage stored at room and refrigerated temperatures, respectively.This discrepancy may be due to differences in the initial microbial load and source of raw materials, processing methods and levels of hygiene observed during production.

Generally, tamarind beverage produced by the traditional processing method had high microbial load .This may be due to the fact that tamarind beverage, like many other traditional Nigerian beverages, is produced in homes and little attention is given to hygienic rules in the selection of processing materials and activities. The beverage is therefore highly susceptible to contamination by the microflora of the raw materials, utensils, and environment. The processing and storage conditions associated with traditional processing methods can encourage the presence of pathogenic or spoilage microorganisms in the beverage. Refrigeration caused a further decline in the microbial load of the beverage. The low microbial counts of the pasteurized and refrigerated beverage samples may be due to the fact that pasteurization temperature can destroy the mesophilic microorganisms while low temperature can control the proliferation of those present. The marked increase in the shelf life of the beverage when it was preserved with sage-oil agreed with the observation of Oyawoye et al. [16]. Sage-oil may inhibit microorganisms by interfering with their cell membranes, enzyme activity or genetic mechanisms. [16]

Table 2. Antimicrobial activity of sage oil. (ug/ml).

Microorganism	Cyclohexane Extract	Dichloromethane Extract	Ethanol Extract
Bacillus cereus	500	125	125
Staphylococcus epidermidis	500	65	500
Micrococcus luteus	250	250	125
Vibrio parahaemolyticus	125	500	125
Staphylococcus aureus (ATCC 6633BB)	65	32.5	125
Pseudomonas aeruginosa (ATCC 27853)	125	125	500
Klebsiella pneumoniae NCIMB 9111)	500	125	125

Table 3. Microbial load during storage of spiced tamarind beverage produced by traditional processing method

Storage Temperature	Microbial count counts log (log CFU/ml)			
	Period of storage(days)	Total plate counts	Total molds and yeasts counts	Coliform counts
Room	0	3.98	4.58	NG
	2	4.58	5.70	NG
	6	5.2	5.75	NG
Refrigerated	0	4.46	5.03	NG
	2	4.96	5.57	NG
	8	5.25	5.67	NG

*NG = no growth

Table 4. Mean hedonic scores during storage of tamarind beverage containing (100 mg sage-oil/100 ml beverage) produced by traditional processing method.

	Mean hedonic scores				
Storage temperature	**Period of storage (days)**				
		Color	**Aroma**	**Taste**	**Overall acceptability**
Room Refrigerated	0	6.1^{a}	6.5^{a}	6.2^{a}	5.9^{a}
	0	6.1^{a}	6.5^{a}	6.2^{a}	5.9^{a}
	2	6.1^{a}	6.2^{a}	6.0^{ab}	5.8^{a}
	4	5.8^{ab}	5.9^{b}	5.8^{bc}	5.7^{ab}
	6	5.5^{b}	5.7^{b}	5.5^{ab}	5.3^{ab}
	8	5.0^{c}	5.1^{d}	5.2^{d}	5.2^{ab}

a: Profile Attribute Analysis . b :Texture Profile Method c :Revised Math Attitude Scale d: Paired preference

4.3. Sensory Qualities

Table 4 shows the result of the sensory evaluation of tamarind beverages produced by the traditional method. Tamarind beverage produced by the traditional processing method was initially rated “like slightly” for color (6.1), taste (6.2), and overall acceptability, and “like much” (6.5) for aroma (Table 4). During storage at room temperature, the sensory scores for all the attributes of the beverage produced by the traditional processing method decreased to “neither like nor dislike” on day 4. At refrigerated temperature, the samples were rated “neither like nor dislike” for all the quality attributes except aroma, which was rated dislike slightly at the end of storage life.

5. Conclusion

The inclusion of sage oil at 100 mg/100 ml in the processing of tamarind beverage by enhanced the sensory qualities and shelf life of the beverage. The total acidity, color, and browning index of beverages increase while the pH, cloudiness, ash, total solids, soluble solids, ascorbic acid, and total sugar decrease during storage. Fewer microorganisms are present in foods with higher antimicrobial activity such as sage.

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