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Effect of Critical Processing Variables on Sesame Milk Quality

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Abstract: Problem statement: In previous study sesame milk was developed. The developed milk had slightly acceptable dispersion stability and taste and there were a need to improve it. **Approach:** Dispersion stability and taste were improved by investigating the interaction effects of sesame seed to water ratios (10 or 12 or 14 % sesame seeds) and different pasteurization treatments (65°C-30 min or 75°C-5 min or 85°C-5 min). **Results:** The best sesame seed concentration was 12% and the best heat treatment was 85°C -5 min. **Conclusion/Recommendation:** Sesame seed concentration and heat treatment of sesame milk had significant effect on sesame milk dispersion stability and sensory properties.

Key words: Sesame milk, dispersion stability, heat treatment

INTRODUCTION

There is a great interest in developing new products from decorticated sesame seed due to its nutritional (Evans and Bandemer, 1967; Boloorforooshan and Markakis, 1979), functional (Oshodi *et al*., 1999) and health properties (Kapadia *et al*., 2002; Nakano *et al*., 2002; Sirato-Yasumoto *et al*., 2001; Noguchi *et al*., 2001; Takeuchi *et al*., 2001). These properties make sesame a valuable source of protein and other nutrients. Currently, their major uses (other than sesame oil pressing) are limited to: garnish of bakery products and in production of Tahina (sesame butter), the later is incorporated in Hummus and eggplant dip. Tahini and sesame are also used in the manufacturing of confectionaries such as Halawa Tahinia and sesame bars (Altschul, 1985). In a recent study (Quasem *et al*., 2009) in which a basic procedure was proposed for the production of sesame milk, an invention step was suggested concerning the effect of pretreatments of sesame seeds and the effect of sesame seeds source on the quality of the produced milk. The produced sesame milk has acceptable dispersion stability and sensory properties, but there is still a need for further improvement of sesame milk quality. Several studies reported the importance of controlling the ratio of vegetables to water in order to optimize the yield and sensory acceptability. Therefore, the aim of this study was to investigate the effects of interaction between initial sesame seed: water ratio and different pasteurization treatments on the quality of sesame milk.

MATERILAS AND METHODS

Sesame seed: Decorticated sesame seed (originated from Ethiopia) was obtained from Al-Kasih Factories Group for Food Stuff in Zarqqa/Jordan and characterized as sweet sesame (bitter taste was absent)

Instruments: The following instruments were used throughout the study: blender (Hamilton); homogenizer (Silverson), drying oven (Memmert, Germany); water bath (Model FDP8D, Techne Cambridge Ltd. USA); Kjeldahl Apparatus (Velp scientifica, Italy).

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Preparation of sesame milk: Decorticated sesame seed and tap water were weighed to give the desired sesame seed percentage. Sesame seed was transferred to the blender vessel and a small portion of the weighed water was added to facilitate the progress of mixing/grinding process. The blender was operated at highest speed for 10 min. After finishing the grinding process, the remaining quantity of water was added and mixed thoroughly. The resulted sesame dispersion was homogenized (in portions of 300 g) for 5 min using lab homogenizer. The temperature reached due to homogenization was ca. 52 ±2°C. The homogenized sesame milk base was squeezed through cheesecloth to separate coarse particles. The resulted milky solution was weighed, readjusted to its original weight (before filtration) by adding tap water, sweetened by the addition of 2% sucrose, mixed thoroughly, filled in a beaker and heated in boiling water bath with manual stirring. The heat-treated milks was filled in 50 mL presterilized glass tubes (50 mL of sesame milk per tube), cooled (by immersing the tubes in ice bath for 5 min) and then stored refrigerated (at 4°C).

Analytical procedures:

Moisture, protein, ash and fat percentages determination: Moisture, protein (N×6.25), ash and titratable acidity (as lactic acid) were determined by AOAC (1960). Fat was determined using modified Majonnier method (AOAC, 1960).

Total solids yield of sesame milk: Total solids yield of sesame milk was calculated by the following formula: % Total solids yield = ((Percentage of total solids in sesame milk)/(total solids concentration (at weighing step before mixing))×100

Protein yield of sesame milk: Protein yield of sesame milk was calculated by the following formula: % Protein yield = ((Percentage of protein in sesame milk)/ (Initial protein concentration (at weighing step before mixing))×100

Fat yield of sesame milk: Fat yield of sesame milk was calculated by the following formula: % Fat yield = ((Percentage of fat in sesame milk)/(Initial fat concentration (at weighing step before mixing))×100

Dispersion stability of sesame milk: As described by Quasem *et al*. (2009).

Experimental design for dispersion stability of sesame milk experiment: Split plot design (3×3) was used to study the interaction between the two factors. Two replicates were made for each treatment with a sample size of 50 mL of sesame milk.

Treatments evaluation for dispersion stability of sesame milk experiment: The treatments were evaluated by measuring the dispersion stability in pasteurized sesame milk in each day during the storage period under refrigeration (3 days at 4°C).

Statistical analysis for dispersion stability of sesame milk experiment data: All statistical analyses were carried out using SAS (SAS Institute Inc., Cary, USA, Release 8.02, 2001). Comparisons of means with respect to the influence of different sesame seed concentration and different heat treatments were carried out using the GLM procedure considering a split plot design (3×3). The LS-means was employed in order to maintain an experiment wise of 5% (Steel and Torrie, 1980).

Sesame milk proximate composition, yield and sensory attributes experiment: The proximate composition, yield and sensory attributes were investigated for pasteurized (at 75°C for 5 min) sesame milks with different initial sesame seed percentages (10, 12 and 14%). An experiment was performed to select the optimum level of sugar to be added to sesame milk. This experiment was performed on milk with 12% initial sesame seed percentage and different levels of sugars (1, 1.5, 2, 2.5 and 3% sucrose). Based on this experiment 2% sugar was selected as the best level as indicated by the expert panel sensory evaluation. Accordingly, 2% sugar was added to the three milks with different total solids concentrations. Samples for chemical analysis were drawn before the addition of sugar. Two replicates were made for each treatment and the sample size was 300g of sesame milk.

Treatments evaluation for sesame milk proximate composition, yield and sensory attributes experiment: The treatments were evaluated for three tracks:

- Measuring the proximate composition of the produced sesame milk (before the addition of 2% sugar)
- Measuring sesame milk yield of total solids, protein and fat
- Sensory evaluation using 5-points hedonic scale for the following attributes: aroma, taste, color, mouth feel and overall acceptability

Statistical analysis for sesame milk proximate composition, yield and sensory attributes experiment data: The data were analyzed statistically by analysis of variance (ANOVA) using: (a) completely randomized design for yield results (b) completely randomized block design for sensory evaluation results. Means separation was done using LSD test with significance at $p < 0.05$. The analysis was performed using SAS system (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Dispersion stability: The dispersion stability values of pasteurized sesame milk (Table 1) revealed that the pasteurization treatment at 75°C -5 min (regardless of the percentages of sesame seed used) generally resulted in higher dispersion stability values in comparison with the other two pasteurization treatments (65°C -30 min and 85°C -5 min). The only exception was the pasteurized sesame milk produced from sesame milk with 10% initial sesame seed percentage, which showed slightly (not significant) higher dispersion stability in the second and third day of storage when pasteurized at 65°C -30 min. For this reason, pasteurization treatment at 75°C -5 min was selected. Regarding the initial percentages of sesame seed, Table 1 shows that the dispersion stability values were significantly increased with increasing the initial sesame seed percentage. To select the optimum initial concentration of sesame seed, additional tests were performed to investigate their effect on milk yield and sensory acceptance.

Table 1: Effect of interaction between different initial sesame percentages and different pasteurization treatments on sesame dispersion stability during storage (at 4°C)

% Initial Sesame seed Concentration (as it is*)	Dispersion stability of sesame milk pasteurized at different heat treatments**								
	65°C -5 min			75°C -5 min			85°C -5 min		
	1st day	2nd day	3rd day	1st day	2nd day	3rd day	1st day	2nd day	3rd day
10	0.81c	0.66c	0.59c	0.87b	0.64c	0.56c	0.62b	0.51c	0.47c
12	0.88b	0.79b	0.68b	0.95a	0.87b	0.82b	0.75a	0.69b	0.63b
14	0.97a	0.95a	0.93a	0.98a	0.95a	0.95a	0.77a	0.73a	0.70a

*: % moisture in sesame seed was 4.2%, **: Means within the same column followed by the same letter do not differ significantly (P<0.05)

Table 2: Effect of the using different percentages of sesame seed on proximate composition and yield of the prepared sesame milk

% Initial sesame seed Concentration (as it is*)	Proximate composition (g $100g^{-1}$ sesame milk)					Yield (%)**		
	Total solids	Protein	Fat	Ash	Nitrogen free extract by difference	Total solids	Protein	Fat
10	8.28	2.20	4.69	0.34	1.05	86.48a	87.65a	87.33a
12	9.95	2.52	5.68	0.42	1.34	86.56a	87.64a	88.15a
14	11.21	2.97	6.43	0.48	1.34	83.66a	88.77a	85.54a

*: Moisture content in sesame seed was 4.2, **: Means within the same column followed by the same letter do not differ significantly (P<0.05)

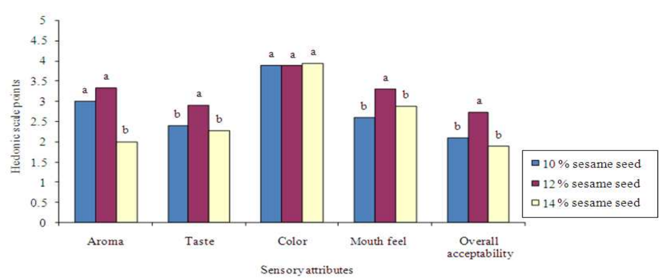

Fig. 1: Effect of different initial sesame seed percentages on sesame milk sensory attributes. Values with different letter within each sensory attribute are significantly different (p<0.05) according to LSD test

Proximate composition and yield: Results in Table 2 show that there are no significant differences in the percentage of total solids, protein and fat yield between the milks prepared with different initial sesame seed percentages.

Sensory evaluation: Before testing the effect of different initial sesame seed concentration on the acceptability of the produced milks, a pre-experiment was performed to select the best level of sugar (sucrose) in milk started with 12% sesame seed. The result of expert panel test revealed that the optimum sugar concentration was 2%. Accordingly, 2% sucrose was added to all samples before pasteurization. Results obtained from the sensory evaluation using 5-points hedonic scale (Fig. 1) indicated that sesame milk with initial sesame percentage of 12% had a significantly higher overall acceptability score (2.73) than milks with 10 and 14% initial sesame seed percentages (2.10 and 1.89 respectively).

The milk prepared with an initial sesame seed percentage of 12% was found to have superior sensory attributes compared to that prepared from 14% initial sesame seed in terms of aroma, taste and mouthfeel, while they had superior taste and mouthfeel when compared with milk with 10% initial sesame seed concentration.

CONCLUSION

This study proved that the initial sesame seed concentration and heat treatment of sesame milk had a significant effect on sesame milk yield and sensory properties. Results indicated that the best sesame seed concentration was 12% and the best heat treatment was 85°C -5 min.

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