Effect of mango juice on frozen yoghurt Quality

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Abstract: The effect of different amounts of mango juice (0.0%, 25%, 50% and 75% vol/w) on the quality of frozen yoghurt was investigated. All samples ingredients (yoghurt, low fat, sugar cream, gum Arabic, sugars) were mixed with the indicated amount of juice and then transferred to an ice cream machine so that the final product could be packed into plastic cups and stored in a deep freezer at -18^0 C for 45 days. Samples were analyzed on day 0, 15, 30 and 45 of the storage period.

Physicochemical analyses showed that, the 75% mango juice had the highest content of total solids (28.80%), protein (9.60%), fat (14.60%), ash (2.50%) and fiber (1.20g/100g). The pH of all samples decreased, while the titratable acidity increased during storage. Organoleptic characteristics were significantly affected (P≤0.05) by the presence of mango juice. The best appearance (4.7%), texture (4.6%), flavour (4.8%) and over all acceptability (4.7%) were recorded in containing 25% mango juice. The storage period also significantly (p≤0.05) affected the quality of the frozen yoghurt with the best scores obtained at the beginning of the storage period.

Key words: frozen yoghurt, mango juice, storage

Introduction

Frozen yoghurt is a dessert similar to ice cream, but made with yoghurt rather than ice cream. It tends to be healthier than ice cream, so many people choose it as an alternative. It is important to realize, however that frozen yoghurt while richer in many minerals and nutrients than ice cream, is still not as healthy as regular yoghurt – a fact many people overlook (Yousef, 2013).frozen yoghurt is a fermented food, made by adding live bacterial cultures to milk. These bacteria provoke fermentation in the milk, releasing lactic acid the acid in turn thickens the milk proteins and causes them to form a mass, while guarding against non-beneficial bacteria (Mbaeyi, 2010). Frozen yoghurt is usually only considered true yoghurt if live bacteria remain at

the end of the creation process. When a person consumes frozen yoghurt, these live bacteria enter the body and assist other beneficial bacteria (Galal, 2004).

Frozen yoghurt has a number of benefits over other dairy products. Perhaps most importantly, frozen yoghurt contains enzymes that assist in breaking down dairy, allowing many people with lactose intolerance to ingest yoghurt and frozen yoghurt with little or no ill effects (Guda, 2004).Frozen yoghurt also tends to have high levels of protein and many important minerals.

Immature mango fruit are astringent, acid and rich in vitamin C, where ripe mangos are sweet. Rich in provitamin A, moderate in vitamin C. The proximate chemical composition of some well known varieties of mango reported in biochemistry of fruit and their product are 16-86 moisture %, 14-24 totals soluble, 4-4.9 pH value 0.14-0.64% titratable acidity, 10.5-18.5% total sugar, 1500-1700 mg/100g total carotenoids depending of variation in variety and climatic condition. The chemical composition constituent carbohydrates ,organic acids, protein and amino acids, fatty acid and odoriferous, pigments, substances ,polyphones, vitamin and minerals (Elemo,2001).

The aim objective of this study was to investigation the affect different levels (0, 25, 50 and 75%) of mango juice on frozen yoghurt quality.

Materials and Methods

Materials

Fresh yoghurt was obtained from the Faapy Company, (gandatto, Sudan) and mangos were obtained from the ALAnfaal supermarket (Khartoum, Sudan).Sugar was purchased from the kenana sugar company (Sudan) and gum Arabic was from the Gum Arabic company (Khartoum, Sudan).low fat, sugar cream made in sudan.

Methods

Fruits preparation: Mangos were cut into small (~10 mm) pieces. The fruits were mixed in machine syrup and frozen at -18 ^{0}C until use.

Frozen yoghurt preparation

Frozen yoghurt was prepared as described by guner *et al*., (2007) and formulated as 15% sugar, 0.5% Arabic gum, and yoghurt made from cow milk. Four different amounts of mango juices (0.0%, 25%, 50%, and 75% vol/w) were incorporated by manual mixing. The mixture was then transferred to an ice cream machine. The final product (250g) was distributed into plastic

cups and stored in deep freezer (-18 ^{0}C) for 45 days with analyses conducted on day 0, 15, 30, and 45 (Fig.1.).

Physicochemical analysis of frozen yoghurt

pH values of the frozen yoghurt were determined with a pH meter (double electrode) according Atherton and Newlander (1977). Titratable acidity, as well as fat and ash contents were determined according to methods described by Bradlley *et al*., (1992). The total solids content was determined with a hand-held refraction meter made in Germany and the protein content was determined by Kjeldahl method according AOAC (1990).

Sensory evaluation: The sensory evaluation according method by Ihekorone and Negoddy (1985).

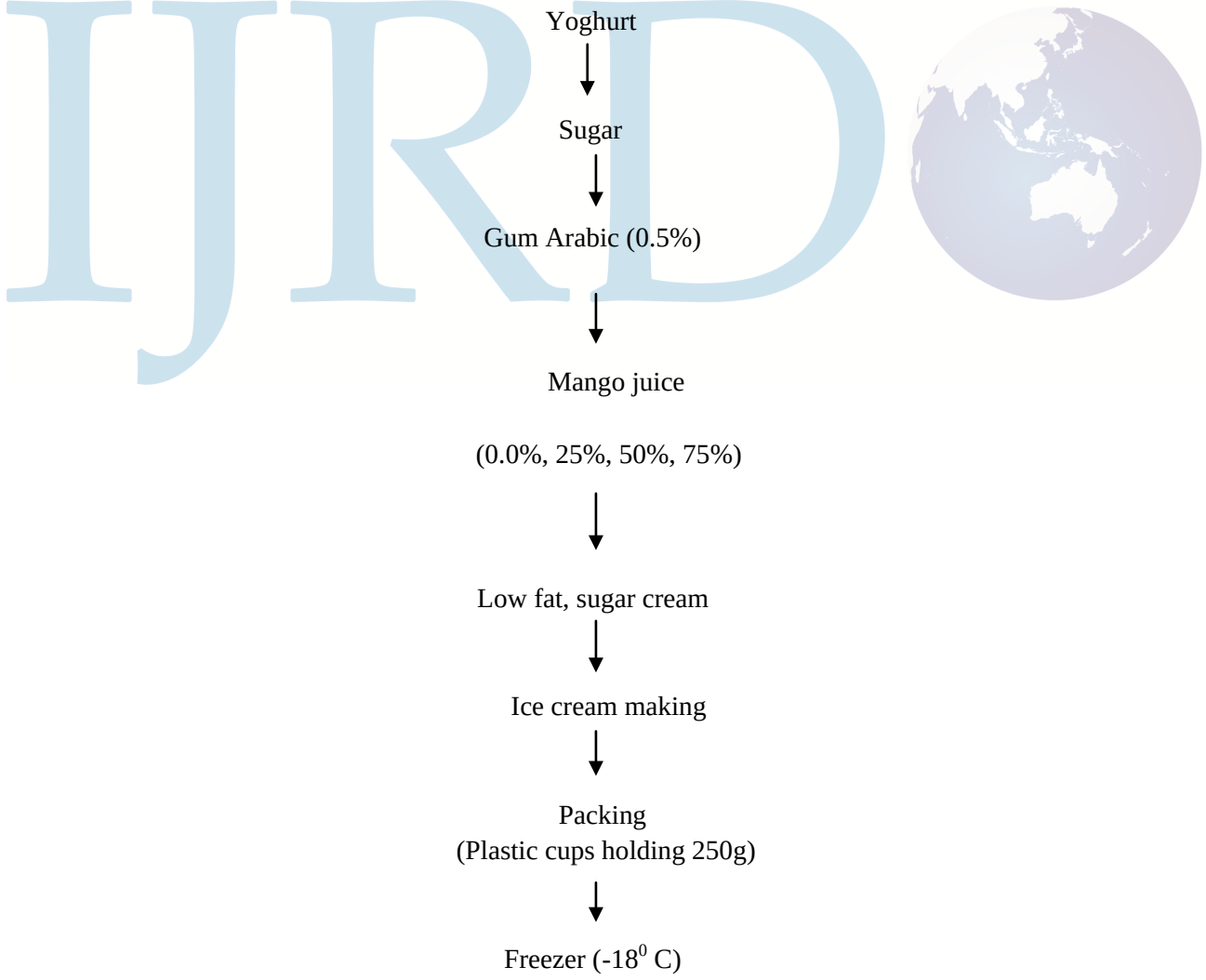

Fig.1. Preparation of mango frozen yoghurt

Statistical analysis: Data were subjected to ANOVA analysis using SAS and means were separated using Duncan's multiple range test (DMRT).

Results and Discussion

Physicochemical analysis of frozen yoghurt

Total solids

The highest total solid (28.80%) level was seen for the yoghurt sample containing 75% mango juice, while the control sample that lacked mango juice had lowest level (22.50%). Samples with 25% and 50% mango juice showed intermediate value ($p \leq 0.05$). The addition of mango juice, which contains total solids of 24.6g/100g (USDA,2015) increased the amount of total solid in the yoghurt samples (Table 1).This result is consistent with earlier studies (Mbeayi *et al.*,2010)

An earlier reported by Yousef *et al.*, (2013) showed that the addition of fruit pulp increased the total solid of frozen yoghurt therefore decreases in the moisture content of frozen yoghurt. Kroger *et al.*,(1973) stated that the fruit yoghurt total solid content is strongly dependent on fruit total solid.(Duitschrer *et al.*,1972;Mohammed, 2008) also found that the addition of mango Ox heart juice to yoghurt led to decrease total solid of all treatment due to low total solid of mango Ox heart juice. Ibrahim *et al.*, (1995).

Protein content

Mango juice had protein content of 4.40g/100g (USDA, 2015). The highest protein content (9.60%) was seen for the sample containing 75% mango juice .The control sample had the protein content (6.30%), and the other samples had intermediate values ($P \leq 0.05$).Table 1

The addition in mango pulp in yoghurt increased the protein content (Mbeayi *et al.*,2010).Mohammed *et al.*,(2008) concluded that the protein content decreased when the levels of mango Ox heart juice increased due to the low protein content of this type of mango. Jiancai *et al.*,(2006) stated that the addition of mango juice in frozen yoghurt increased the protein content. Elemo *et al.*, (2001); Khalewue *et al.*,(1950) also found that the protein content of frozen yoghurt increased from 3.62% to 4.1%. El-owni *et al.*, (2009) concluded that the protein content of mango ice cream increased from 2.32% to 3.30%.

Fat content

The highest fat content (14.60%) was seen for sample containing 75% and lowest fat content was seen for the control samples (12.40%). The other samples had intermediate ($P \leq 0.05$) This result indicate that the fat content increased with increasing levels of mango juice (Table 1),as would be expected given that the (USDA,2015) value for mango fat content is 1.20g/100g

Mbeayi *et al*.,(2010);Muhammed *et al*.,(2005) also found that the fat content increased with increasing in concentration of mango bush juice. Naz *et al*., (2012) stated that the addition of mango fruit increased fat content of frozen yoghurt from 2.240% to 2.580%. The fat content of mango ice cream increased from 4.70% to 8.91% El-owni *et al*., (2009).

Ash content

The highest ash content (2.50%) was seen for sample containing 75% of mango juice and The control sample had the lowest amount of ash (1.70%). the other samples had intermediate values ($P \leq 0.05$). The ash content increased with increasing levels of mango juice, which is consistent with results from earlier studies (Mbeayi *et al*., 2010; Muhammed *et al*., 2005; El-owni *et al*., 2009).

Fiber content

The highest fiber content (1.20g/100g) was obtained from the yoghurt sample containing 75% mango juice. While the control sample that lacked juice had no fiber content. This results were expected given the (USDA, 2015) values of 0.4g/100g fiber content for mango juice. The 25% and 50% juice samples had intermediate values ($P \leq 0.05$).Thus indicating that the fiber content increased with increasing levels of mango juice (Table 1).These result are also in agreement with studies by (Mahattanatawe *et al*.,2006;Hossian *et al*.,2012).

Table 1. Effect of mango juice on physicochemical properties of frozen yoghurt

Item	Mango juice content (%)			
	0	**25**	**50**	**75**
Total solid	$22.50^{d} \pm 0.11$	$25.80^{c} \pm 0.13$	$27.30^{b} \pm 0.15$	$28.80^{a} \pm 0.16$
protein	$6.30^{d} \pm 0.06$	$7.39^{c} \pm 0.08$	$8.40^{b} \pm 0.07$	$9.60^{a} \pm 0.05$
Fat	$12.40^{c} \pm 0.03$	$13.50^{b} \pm 0.02$	$14.00^{a} \pm 0.04$	$14.60^{a} \pm 0.06$

Ash	1.70^{b}±0.02	1.85^{b}±0.05	2.10^{a}±0.07	2.50^{a}±0.04
Fiber (g/100g)	0.0^{d}±0.00	0.70^{c}±0.06	0.90^{b}±0.08	1.20^{a}±0.09

*Means ±SD. different superscript letters in columns and rows indicate significant differences (P≤0.05)

pH value

We next examined the effect of mango juice addition on the pH levels of frozen yoghurt during different storage period (Table 2). The control sample showed the highest pH value (5.51) and the 75% juice sample was the most acidic at (4.00). The other samples showed intermediate pH values (P≤0.05). Thus the addition of mango juice increases the acidity of frozen yoghurt to reduce the pH. Furthermore, the length of storage significantly (P≤0.05) affected the pH value of frozen yoghurt. As the frozen yoghurt was stored for longer periods, the pH values dropped such that the samples early in storage had lowest pH was seen for the oldest samples.

The addition of mango juice decreased the pH value of frozen yoghurt (Abdalla *et al*.,2000;Guda *et al*.,2004) and Muhammed *et al*.,(2005) found that the addition of fruits lead to decrease pH value of frozen yoghurt during storage time, the pH value of all the samples decreased progressively due to the excessive sugar fermentation and presence of lactic acid bacteria (Galal *et al*.,2004;Naz *et al*.,2012) also concluded that the pH value of mango frozen yoghurt decreased from 6.4% to 5.1%.Munir *et al*.,(1985) noticed that the pH value of mango frozen yoghurt decreased during storage time.

Table 2. Effect of mango juice on pH value of frozen yoghurt during storage

Storage period (days)	Mango juice content (%)			
	0	25	50	75
0	5.51^{a}±0.16	5.22^{b}±0.13	5.18^{c}±0.13	5.15^{cd}±0.14
15	5.25^{b}±0.17	5.00^{d}±0.19	4.90^{e}±0.12	4.80^{f}±0.09
30	4.90^{e}±0.15	4.70^{fg}±0.18	4.50^{h}±0.19	4.40^{hi}±0.13
45	4.60^{g}±0.12	4.35^{i}±0.09	4.20^{J}±0.16	4.00^{k}±0.17

*Means ±SD. different superscript letters in columns and rows are significant differences (P≤0.05)

Titratable acidity

The highest titratable acidity (0.59%) was obtained for frozen yoghurt containing 75% mango juice, while the control sample had the lowest value (0.21%). The titratable acidity increased with increasing levels of mango juice and the time of storage (Table 3).

These results are consistent with those of (Abdalla *et al*., 2000; Kosikowski *et al*., 1997) which showed that the addition of mango juice increased the titratable acidity of frozen yoghurt. During storage period the titratable acidity increased due to excessive sugar fermentation by lactic acid bacteria (Galal *et al*., 2004; Celik *et al*., 2006).The titratable acidity of mango frozen yoghurt increased during storage time Naz *et al*., (2012).

Table 3. Effect of mango juice on titratable acidity of frozen yoghurt during storage

Storage period (days)	Mango juice content (%)			
	0	25	50	75
0	0.21^{N}±0.06	0.32^{k}±0.09	0.36^{J}±0.03	0.38^{i}±0.11
15	0.27^{m}±0.03	0.41^{h}±0.05	0.48^{f}±0.08	0.46^{g}±0.07
30	0.31^{L}±0.02	0.47^{fg}±0.04	0.50^{e}±0.09	0.53^{c}±0.05
45	0.32^{k}±0.08	0.51^{d}±0.06	0.54^{b}±0.07	0.59^{a}±0.02

*Means ±SD. different superscript letters in columns and rows are significant differences (P≤0.05).

Organoleptic properties of mango frozen yoghurt

We next evaluated changes in organoleptic properties resulting from the addition of mango juice of frozen yoghurt. The highest score for appearance (4.7), texture (4.6), flavour (4.8) and over all acceptability (4.7) were obtained for samples containing 25% mango juice, while the control samples had the lowest scores (3.3, 3.6, 3.2 and 3.4 respectively). The storage period significantly (p≤0.05) affected the quality of mango frozen yoghurt, such that the highest quality was seen at the beginning of the storage period, and the value decreased over time (Table 4)

Indeed. Hasan *et al*., (2012) found that the appearance scores decreased with increasing concentration of fruit (Asuman *et al*.,2007;Celik *et al*.,2006;Farhath *et al*.,2014) also said that during storage period, appearance score decreased progressively with the storage time due to increase in moisture content with storage time. These results are consistent with those of (Taraki *et al*., 2003; Goff *et al*., 2006; Mbeayi *et al*., 2010; El-Gazzar *et al*., 1992)

Table 4. Effect of mango juice on organoleptic quality of frozen yoghurt during storage

storage period (days)	**Appearance** Mango juice content (%)				**Texture** Mango juice content (%)			
	0	**25**	**50**	**75**	**0**	**25**	**50**	**75**
0	4.0^{h}±0.09	4.7^{a}±0.02	4.5^{c}±0.03	4.3^{e}±0.06	4.1^{f}±0.08	4.6^{a}±0.03	4.5^{b}±0.04	4.4^{c}±0.05
15	3.8^{i}±0.11	4.6^{b}±0.03	4.3^{e}±0.05	4.2^{f}±0.04	3.9^{g}±0.09	4.5^{b}±0.02	4.4^{c}±0.05	4.3^{d}±0.06
30	3.6^{J}±0.12	4.4^{d}±0.05	4.2^{f}±0.07	4.1^{g}±0.08	3.7^{h}±0.07	4.4^{c}±0.04	4.3^{d}±0.06	4.2^{e}±0.03
45	3.3^{k}±0.09	4.3^{e}±0.04	4.1^{g}±0.06	4.0^{h}±0.07	3.6^{i}±0.11	4.3^{d}±0.05	4.2^{e}±0.02	4.1^{f}±0.08

Storage Period (days)	**Flavours** Mango juice content (%)				**Over all acceptability** Mango juice content (%)			
	0	**25**	**50**	**75**	**0**	**25**	**50**	**75**
0	$4.0^{g}\pm0.06$	$4.8^{a}\pm0.01$	$4.6^{b}\pm0.02$	$4.4^{d}\pm0.03$	$4.0^{g}\pm0.09$	$4.7^{a}\pm0.02$	$4.4^{c}\pm0.04$	$4.2^{e}\pm0.06$
15	$3.7^{h}\pm0.07$	$4.6^{b}\pm0.03$	$4.5^{c}\pm0.04$	$4.3^{e}\pm0.05$	$3.8^{i}\pm0.11$	$4.5^{b}\pm0.03$	$4.3^{d}\pm0.05$	$4.1^{f}\pm0.07$
30	$3.5^{i}\pm0.08$	$4.5^{c}\pm0.02$	$4.4^{d}\pm0.05$	$4.2^{f}\pm0.07$	$3.5^{J}\pm0.12$	$4.3^{d}\pm0.06$	$4.2^{e}\pm0.07$	$4.0^{g}\pm0.08$
45	$3.2^{J}\pm0.09$	$4.4^{d}\pm0.04$	$4.2^{f}\pm0.06$	$4.0^{g}\pm0.08$	$3.4^{k}\pm0.13$	$4.2^{e}\pm0.05$	$4.1^{f}\pm0.04$	$3.9^{h}\pm0.09$

*Means ±SD. different superscript letters in columns and rows are significant differences ($P\leq=0.05$)

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