Zagazig J. Agric. Res., Vol. 36 No. (1) 2009 155 - 169

CHEMICAL COMPOSITION AND SOME PROPERTIES OF YOGHURT DRINK WITH FRUIT

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Accepted 22/1/2009

ABSTRACT: Yoghurt drink with fruit was made from yoghurt produced from a mixture of buffaloe's and goat's milk at ratio 1:1 and the effectiveness of different fruit types (guava, mango or banana) at level of 5%, 10% or 15% of each on chemical composition, some rheological and organoleptical properties were studied. The results indicated that the total solids (TS), ash, carbohydrate, acidity, NCN/TN, NPN/TN, WPN/TN, viscosity and caloric values significantly increased with increasing the ratio of added fruit, while the fat and protein contents were not affected. On the other hand, the addition of fruit significantly decreased the amount of whey separation. The flavour, body and texture of all treatments were significantly improved with increasing the ratio of fruit and using ratio of 15 % was more preferred than 5 or 10 % and the mango was preferred than the other fruits.

Keywords: Yoghurt, drink, fruit, fermented milk, chemical composition.

INTRODUCTION

In recent years a large increase in the popularity of fermented milk products has happened. The consumers search for new and unique yoghurts to maintain the healthy eating habits (Adhikari *et al.,* 2000, Pereg *et al.,* 2005).

Yoghurt drink became popular in Egypt. It is consumed either as a part of diet or as a refreshing drink. It is a nutritiously a balanced food containing almost all the nutrients present in milk as well as valuable therapeutic properties (Bartram *et al.,* 1994., Yuceer *et al.,* 2001, and Lubbers *et al.,* 2004).

Fermented milk products can be made from cow's, goat's, sheep's, buffalo's, and camel's milks (Gibson 1996).

During recent years, an increasing interest has been focused on goat's milk because of its healthy effect beyond its nutritional value. Goat's milk has been described as having a higher digestibility and lower allergenic properties than cow's milk. In addition goat's milk has been characterized by certain therapeutic values in human nutrition (Martin *et al.,* 2003; and Herrero and Requena, 2006).

Yoghurt drink could be made from whole milk, low fat or skim milk with any fortification with nonfat milk solids for increasing solids content of the basic mixture. Also yoghurt drink could be classified into sweetened, unsweetened plain and flavoured drinks (Vedamuthu,1991).

Drinking yoghurt is purchased by the consumer on the basis of flavour and ingredients, there are several different flavours used in their manufacture which may be plain (natural) or in a wide variety of flavours as strawberry, apricot, apple, orange, banana, guava, or mango. Generally, these flavours are added to drinking yoghurt after pasteurization and fermentation have been completed (Anis *et al.,* 1989; Hanafy 1995; Beal *et al.,* 1999; Kozlawska *et al.,* 2002; Martin *et al.,* 2004; and Aly & Galal, 2005).

The objective of this study was to investigate the effect of different ratios and types of fruits on the quality of yoghurt drink made using a mixture of 1:1 buffalo's and goat's milk.

MATERIALS AND METHODS

Materials

Fresh whole buffalo's milk (5.5% fat, 4.3% protein, 0.81% ash and 5% lactose) was obtained from Dairy Technology Unit, Food Science Department, Faculty Agric., Zagazig Univ., and whole goat's milk (3.5% fat, 3.6% protein, 0.84% ash and 4.2% lactose) obtained from the herd of Gemmiza station, Animal production Research Institute, Ministry of Agriculture to produce high fat content yoghurt drink. Cane sugar, fresh fruit (Guava, Mango and Banana) were bought from the local market. Citrus pectin E 440 was obtained from Herbstreith & Fox company-

Neuenburg- Germany. Yoghurt starter *Streptococcus salivarius* subsp. *thermophilus* EMCC104 and *Lactobacillus delbruekii* subsp. *bulgaricus* EMCC1102 were obtained from the Microbiological Resources Center (MIRCEN), Faculty of Agric. Ain Shams Univ., Egypt.

Methods

Preparation of Fruit Pulp

Fully ripe fruits were washed thoroughly under running tap water to remove the dirt. After washing, the guava seeds were removed and the mangos were peeled by a knife and pulp was extracted also the banana were peeled.

Preparation of Fruit Yoghurt Drink

In the light of the results obtained from the first pilot experiments, it was found that yoghurt drink of good quality could be made from yoghurt prepared using 1:1 mixed buffaloe's and goat's milk and diluted with 50% water Table 1.

Baffaloe's milk and goat's milk were heated to 90 °c for 10 min, then each of them was cooled to 40°c. A mixture of buffaloe's milk and goat's milk at ratio 1:1 was used in the manufacture of yoghurt. Yoghurt starter was added at the rate of 2.5 %, and incubation at 40°c was run until setting and complete coagulation followed by cooling at 6-8°c (Tamime and Robinson, 1985).Solution of pectin (0.3%) and cane sugar (4%) were added to pre-boiled chilled water and mixed well, then used to obtain yoghurt drink at ratio 1:1.

The fruit pulp (guava or mango or banana) at the ratio 5, 10, or 15% of each was added to diluted yoghurt and mixed gently in a blender Table 2.

The final product (fruit yoghurt drink) was filled in 200 ml glass bottles and covered with almonuim foil, and kept in refrigerator for chemical composition when fresh and after 5, 10 and 15 days of storage period for acidity, syneresis and organoleptic properties.

Methods of Analysis

Total solids (TS), fat, protein (TN × 6.38), ash and titrtable acidity (as lactic acid %) were determined according to the methods described by (AOAC,1994). Carbohydrate content was calculated by

difference TS- (fat + protein + ash) according to Guzman *et al.* (1999).

The micro-kjeldahl procdure (Ling, 1963) was used for determination of TN, NCN and NPN. Whereas WPN was calculated by difference NCN-NPN.

Whey separation (syneresis) was estimated as given by Koksoy & Kilic, (2004). The caloric value of the resultant yoghurt drink was calculated by the following equation given by Kramsof (1982): (39 fat + 17.2 protein + 16.7 carbohydrates) Kcal/100gm of product.

Viscosity of product (yoghurt drink) was determined by the method of Aryana, (2003) using Rotational Viscometer type Lab.line Model5437, and results expressed as cps.

The organoleptic properties was assessed as recommended by Seham *et al.* (2007) when fresh and after 5, 10 and 15 days of storage period. The maximum points given for flavour, body and texture, acidity and appearance were 45,35,10 and 10, respectively.

Table 1. Chemical composition of mixed milk 1:1 (buffaloe's and goat's) used in yoghurt making

Index	TS %	TP %	Fat %	Ash %	Car %
Mixed milk	13.8	3.9	4.4	0.82	4.68
Yoghurt	13	4.2	4.7	0.89	3.21

TS: total solids TP: total protein Car: carbohydrate

Table 2. Chemical composition of fruits used in preparation of fruit yoghurt drink

Index	TS %	TP %	Fat %	Ash %	Car %
Guava	20.7	1.20	0.4	0.65	18.45
Mango	17.4	0.64	0.3	0.73	15.73
Banana	24.2	1.35	0.2	0.84	21.81

TS, TP and Car see Table 1.

Statistical Analysis

Statistical analysis for the obtained data was carried out according to the methods described by Clarke and Kempson (1997). Experiments were repeated in triplicates and each analysis was carried out in duplicates and the average of results were tabulated.

RESULTS AND DISCUSSION

Chemical Composition, Caloric Value and Viscosity

Table 1 and 2 contain the chemical composition of mixed milk, yoghurt and fruits used in preparation yoghurt drink with fruit.

Table 3 show the gross chemical composition of fruit yoghurt drink made by using buffaloe's and goat's milks (1:1) as affected by the ratio and type of fruit. The results reveal that the moisture content significantly decreased with increasing ratio of fruit but the total solids (TS) increased with increasing ratio of fruit, samples made using banana had a significantly ($P<0.05$) higher TS than other treatments and control. This might be due to the raising of dry matter in banana Table 2.

Fat and protein contents of fruit yoghurt drinks were nearly approached.

Ash significantly increased with increasing ratio of fruit added (guava, mango or banana) and these values were higher than that of the control while banana 15 % had a higher ($P<0.05$) value.

Carbohydrate content significantly increased with increasing ratio of fruit added (guava, mango or banana) and these values were higher than that of the control. This may be due to the increasing of carbohydrate in fruit (guava, mango or banana) Table 2. The caloric value significantly increased with increasing ratio of fruits added.

Viscosity also significantly increased with increasing ratio of fruit (guava, mango or banana) and viscosity of all fruit yoghurt drinks were higher than that of control. This may be due increasing of total solids. These results are in agreement with those obtained by Hanafy (1995), Hatem (1996) and EL-Ghandour (2008).

Acidity (as Lactic Acid %)

Changes in titratable acidity of different treatments are shown in Table 4. Banana yoghurt drink had

Table 3. Gross chemical composition and properties of fruit yoghurt drink as affected by ratio and type of fruit addition (Average of three replicates)

Chemical composition and properties	Control	Guava			Mango			Banana			L.SD
		5%	10%	15%	5%	10%	15%	5%	10%	15%	
Moisture, %	88.48^{a***}	87.96^{bc}	87.39^{de}	86.75^{f}	88.19^{ab}	87.85^{bcd}	87.57^{d}	87.76^{cd}	87.03^{ef}	86.31^{g}	0.38
Total solids, %	11.52^{g}	12.04^{ef}	12.61^{c}	13.25^{b}	11.81^{f}	12.15^{de}	12.43^{cd}	12.24^{de}	12.97^{b}	13.69^{a}	0.35
Fat, %	2.83^{a}	2.80^{ab}	2.78^{ab}	2.75^{ab}	2.78^{ab}	2.75^{ab}	2.70^{b}	2.80^{ab}	2.78^{ab}	2.73^{ab}	0.12
Protein, %	2.20^{a}	2.19^{a}	2.19^{a}	2.17^{a}	2.17^{a}	2.15^{ab}	2.11^{b}	2.20^{a}	2.19^{a}	2.18^{a}	0.05
Ash, %	0.43^{e}	0.44^{de}	0.46^{cde}	0.47^{bcd}	0.44^{d}	0.47^{bcd}	0.49^{abc}	0.46^{cde}	0.50^{ab}	0.52^{a}	0.03
Carbohydrate,%	6.06^{f}	6.61^{e}	7.18^{bc}	7.86^{ab}	6.42^{ef}	6.78^{de}	7.13^{cd}	6.78^{de}	7.50^{bc}	8.26^{a}	0.41
Caloric value*	249^{e}	257de	266^{bc}	276^{a}	253^{e}	257de	261^{cd}	260^{cd}	274^{ab}	282^{a}	8.91
Viscosity**	2067^{g}	3267^{f}	4867^{e}	5533^{c}	4533^{d}	6800^{b}	8733^{a}	3467^{f}	5667^{c}	5533^{c}	304.68

* K cal/100gm ** cps

***Means followed by the same letter(s) are not significantly different according to LSD test at 0.05 level of probability.

L.S.D : Least Significant Difference. Significant at 0.05 level.

Table 4. Acidity (as lactic acid %) of fruit yoghurt drink as affected by ratio and type of fruit addition during storage period at 6 ± 1°C (Average of three replicates)

Storage period (days)	Control	Guava			Mango			Banana			L.S.D
		5%	10%	15%	5%	10%	15%	5%	10%	15%	
Fresh	0.67^{h*}	0.71^{ef}	0.73^{de}	0.76^{bc}	0.68^{gh}	0.70^{fg}	0.72^{def}	0.74^{cd}	0.77^{b}	0.81^{a}	0.02
3	0.75^{h}	0.80^{ef}	0.83^{cd}	0.85^{bc}	0.77^{gh}	0.78^{fg}	0.79^{fg}	0.82^{de}	0.86^{b}	0.89^{a}	0.02
6	0.81^{f}	0.86^{de}	0.88^{cd}	0.91^{b}	0.84^{e}	0.86^{de}	0.89^{bc}	0.87^{cd}	0.91^{b}	0.95^{a}	0.02
9	0.86^{a}	0.94^{a}	0.97^{a}	0.99^{a}	0.91^{a}	0.93^{a}	0.96^{a}	0.96^{a}	0.99^{a}	1.02^{a}	0.16
12	0.92^{e}	1.00^{cd}	1.03^{bc}	1.05^{ab}	0.96^{de}	1.00^{c}	1.02^{bc}	1.02^{bc}	1.07^{a}	1.08^{a}	0.04
15	0.98^{g}	1.05^{ef}	1.07^{cde}	1.10^{bc}	1.03^{f}	1.06^{def}	1.08^{cde}	1.09^{c}	1.13^{ab}	1.16^{a}	0.03

*Means followed by the same letter (s) are not significantly different according to LSD test at 0.05 level of probability.

L.S.D: Least Significant Difference. Significant at 0.05 level

a significantly higher ($P<0.05$) acidity than the other treatments. Acidity increased with increasing the ratio of banana, guava or mango. All fruit yoghurt drinks had higher acidity than the control one. The increasing of acidity of all treatments during storage period is due to the fermentation of sugar to lactic acid. Values of acidity are partiallyin agreement with the range previously reported by Hanafy (1995) and Hatem (1996).

Whey Separation (Syneresis)

Table 5 shows the whey separation either for fresh or stored treatments. In fresh case, all treated samples had no whey separation, while the amount of whey separation increased as the storage period increased. On the other hand, the addition of pectin and fruit (guava, mango or banana) significantly decreased the amount of whey separation. The lowest amount of whey separation was observed in the treatment of mango 15%. These results are in agreement with these reported by Hatem (1996), Koksoy & Kilic (2003), Gad (2004) and EL-Ghandour (2008).

Non Casein N (NCN), Non Protein N (NPN) and Whey Protein N (WPN) Contents

Table 6 shows that the NCN/TN% value significantly increased with increasing ratio of fruit (guava, mango or banana) and 15% added banana had the highest value ($P<0.05$). The NPN/TN% value significantly increased by increasing ratio of fruit (guava, mango or banana) and the lowest value was observed in the control, while the highest value was observed in the treatment of banana 15%. WPN/TN% value significantly increased with increasing ratio of fruit (guava, mango or banana) and the lowest value was of the control. The treatment of 15% banana showed the highest value ($P<0.05$) of all treatments. These results are in agreement with those obtained by Hatem (1996).

Organoleptic Properties

Table 7 shows the organoleptic properties of fruit yoghurt drinks at fresh and during storage period. Flavour significantly increased with increasing ratio of fruit (guava, mango or banana) and the

Table 5. Syneresis (ml/100ml) of fruit yoghurt drink as affected by ratio and type of fruit addition during storage period at 6 ± 1°C (Average of three replicates)

Storage period (days)	Control	Guava			Mango			Banana			L.S.D
		5%	10%	15%	5%	10%	15%	5%	10%	15%	
Fresh	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	N.S
3	5^{a*}	1.3^{b}	0.7^{b}	Nil^{c}	Nil^{c}	Nil^{c}	Nil^{c}	1.3^{b}	0.7^{b}	Nil^{c}	0.68
6	7.7^{a}	2.3^{bc}	1.5^{c}	Nil^{d}	0.3^{d}	Nil^{d}	Nil^{d}	2.5^{b}	1.7^{bc}	Nil^{d}	0.98
9	10.3^{a}	4.7^{b}	2.5^{d}	1.3^{e}	1.5^{e}	Nil^{f}	Nil^{f}	4.0^{bc}	3.5^{cd}	1.5^{e}	1.05
12	14.0^{a}	6.7^{b}	5.8^{b}	2.2^{d}	2.3^{d}	0.5^{de}	Nil^{e}	6.5^{b}	4.3^{c}	1.7^{d}	1.21
15	18.7^{a}	10.5^{b}	9.7^{b}	3.3^{e}	4.0^{de}	1.2^{f}	0.7^{g}	7.8^{c}	5.3^{d}	2.8^{f}	1.34

*Means followed by the same letter (s) are not significantly different according to LSD test at 0.05 level of probability.

L.S.D: Least Significant Difference. Significant at 0.05 level. N.S: Not significant.

Table 6. Percentage of Non casein N (NCN), Non protein N (NPN) and Whey protein N (WPN)/TN of fresh fruit yoghurt drink as affected by ratio and type of fruit addition (Average of three replicates)

Nitrogen index (%)	Control	Guava			Mango			Banana			L.S.D
		5%	10%	15%	5%	10%	15%	5%	10%	15%	
NCN/TN	19.49^{e}	21.18^{d}	21.99^{c}	22.66^{b}	21.11^{d}	21.76^{c}	22.98^{b}	21.84^{c}	22.71^{b}	24.22^{a}	0.55
NPN/TN	7.83^{f}	9.10^{cd}	9.33^{bc}	9.94^{a}	8.83^{de}	9.29^{c}	9.60^{b}	8.71^{e}	9.39^{b}	10.10^{a}	0.30
WPN/TN	11.67^{f}	12.09^{e}	12.61^{cd}	12.73^{c}	12.28^{de}	12.56^{cd}	13.38^{b}	13.13^{b}	13.32^{b}	14.12^{a}	0.39

*Means followed by the same letter (s) are not significantly different according to LSD test at 0.05 level of probability.

L.S.D: Least Significant Difference. Significant at 0.05 level.

Table 7. Organoleptic properties of fruit yoghurt drink as affected by ratio and type of fruit addition during storage period at 6 ± 1°C (Average of 10 panelists)

Storage period (days)	Property	Control	Guava			Mango			Banana			L.S.D
			5%	10%	15%	5%	10%	15%	5%	10%	15%	
Fresh	Flavour (45)	39.4^{bc*}	38.9^{c}	39.3^{bc}	40.3^{abc}	39.4^{bc}	40.7^{abc}	42.3^{a}	39.7^{bc}	41.5^{ab}	42.3^{a}	2.25
	Body & texture (35)	31.1^{bc}	31.3^{bc}	31.6^{abc}	31.4^{bc}	32.3^{ab}	32.5^{ab}	32.8^{a}	30.6^{c}	31.7^{abc}	32.4^{ab}	1.33
	Acidity (10)	8.4^{a}	7.9^{a}	7.9^{a}	7.8^{a}	8.0^{a}	8.2^{a}	8.1^{a}	7.6^{a}	8.0^{a}	8.1^{a}	0.91
	Appearance (10)	8.0^{ab}	8.3^{a}	8.3^{a}	8.0^{ab}	7.4^{b}	8.2^{a}	8.5^{a}	7.3^{b}	8.0^{ab}	8.0^{ab}	0.74
	Total (100)	86.9^{bc}	86.4^{bc}	87.1^{bc}	87.5^{bc}	87.1^{bc}	89.6^{ab}	91.7^{a}	85.2^{c}	89.2^{ab}	90.8^{a}	3.35
5	Flavour (45)	40.0^{de}	39.6^{e}	40.7^{cde}	41.2^{bcd}	41.1^{cd}	42.4^{ab}	42.9^{a}	39.6^{e}	41.7^{abc}	42.4^{ab}	1.27
	Body & texture (35)	32.1^{b}	31.8^{b}	32.5^{ab}	32.5^{ab}	32.4^{ab}	32.7^{ab}	33.3^{a}	31.0^{c}	31.9^{b}	32.5^{ab}	1.06
	Acidity (10)	8.2^{ab}	8.1^{ab}	8.0^{ab}	8.0^{ab}	8.0^{ab}	8.2^{ab}	8.3^{a}	7.5^{b}	7.9^{ab}	8.1^{ab}	0.72
	Appearance (10)	8.3^{ab}	8.5^{a}	8.4^{a}	8.2^{abc}	7.6^{bc}	8.2^{abc}	8.3^{ab}	7.5^{cd}	7.1^{d}	7.0^{d}	0.72
	Total (100)	88.6^{d}	88.0^{d}	89.6^{bcd}	89.9^{bcd}	89.1^{cd}	91.5^{ab}	92.8^{ab}	85.6^{e}	88.6^{d}	90.0^{abcd}	2.24
10	Flavour (45)	37.0^{e}	39.0^{de}	41.0^{bcd}	41.4^{abc}	40.0^{cd}	43.0^{ab}	43.4^{ab}	40.0^{cd}	42.0^{abc}	42.6^{ab}	2.06
	Body & texture (35)	30.0^{de}	31.4^{bcde}	31.6^{abcd}	32.0^{abc}	31.6^{abcd}	33.0^{ab}	33.2^{a}	29.8^{e}	31.2^{cde}	31.8^{abc}	1.63
	Acidity (10)	7.6^{bc}	8.0^{abc}	8.0^{abc}	8.0^{abc}	8.0^{abc}	8.4^{ab}	8.6^{a}	7.2^{c}	8.0^{abc}	8.0^{a}	0.99
	Appearance (10)	7.6^{bc}	8.2^{ab}	8.0^{b}	8.0^{b}	7.6^{bc}	8.4^{ab}	9.0^{a}	7.0^{cd}	6.6^{d}	6.2^{d}	0.99
	Total (100)	82.2^{d}	86.6^{bc}	88.6^{b}	89.4^{b}	87.2^{bc}	92.8^{a}	94.2^{a}	84.0^{cd}	87.8^{b}	88.6^{b}	3.79
15	Flavour (45)	33.2^{e}	36.8^{d}	39.0^{bc}	39.2^{bc}	38.0^{cd}	41.0^{a}	41.4^{a}	37.0^{d}	39.0^{bc}	40.0^{ab}	1.65
	Body & texture (35)	28.0^{d}	30.0^{bc}	30.8^{b}	31.0^{ab}	30.2^{b}	32.0^{a}	32.0^{a}	28.4^{d}	30.4^{b}	31.0^{ab}	1.60
	Acidity (10)	6.8^{c}	7.2^{c}	7.4^{bc}	7.0^{c}	7.6^{bc}	8.2^{ab}	8.6^{a}	7.0^{c}	7.4^{bc}	7.6^{bc}	0.91
	Appearance (10)	7.0^{bcd}	7.2^{bc}	7.8^{ab}	7.2^{bc}	7.2^{bc}	8.2^{a}	8.4^{a}	6.8^{cde}	6.2^{de}	6.0^{e}	0.96
	Total (100)	75.0^{e}	81.2^{cd}	85.0^{b}	84.4^{b}	83.0^{bc}	89.4^{a}	90.4^{a}	79.2^{d}	83.0^{bc}	84.6^{b}	2.99

*Means followed by the same letter (s) are not significantly different according to LSD test at 0.05 level of probability.

L.S.D : Least Significant Difference. Significant at 0.05 level.

highest scores were in treatment of 15% mango and the lowest scores were in the control at 15 days of storage. On the other hand, the body and texture significantly improved by adding fruits (guava, mango or banana) and the treatment of 15% mango had the highest ($P<0.05$) scores. Body and texture decreased with increasing storage periods to 10 and 15 days.

All the tested samples showed nearly the same score of acidity when fresh and after storage period for 15 days. On the other hand, all treatments showed nearly the same score of appearance, while the appearance scores of control and all fruit treatments (guava, mango or banana) decreased at the end of storage due to the wheying off and the banana yoghurt drink had the lowest scores and it decreased with increasing the ratio of banana.

Using 15% (guava, mango or banana) had the highest ($P<0.05$) total scores when it was fresh, and after storage period of 15 days. The mango was more preferred.

The decrease of scores during storage agrees with results of Hanafy (1995), Hatem (1996) and EL-Ghandour (2008).

Finally, the observed trend of results encouraged the researcher to recommend using fruits in making yoghurt drink not only as flavouring agents but also as nutrients. In this study the mango yoghurt drink, as a whole, is preferred.

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التركيب الكيميائى وبعض خواص مشروب اليوجورت بالفاكهة

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تم تصنيع يوجورت باستخدام خليط من اللبن الجاموسى و لبن الماعز بنسبة ١:١ ومنه صنع مشروب اليوجورت وأضيف إليه أنواع مختلفة من الفاكهة (جوافة أو مانجو أو موز) بنسب ٥٪، ١٠٪ أو١٥٪ لكل منهم وتم بحث أثر ذلك على التركيب الكيميائى وبعض الخواص الريولوچية والتحكيم الحسى للمنتج. أوضحت النتائج أن الجوامد الكلية، الرماد، الكربوهيدرات، الحموضة، النيتروجين الغير كازينى، النيتروجين الغير بروتينى، نيتروجين بروتينات الشرش، اللزوجة وكذا السعرات الحرارية زادت بدرجة معنوية عند زيادة نسبة محضر الفاكهة المضاف بينما محتوى الدهن والبروتين كانت غير معنوية. وعلى الجانب الأخر، فإن إضافة الفاكهة أدت إلى انخفاض معنوى لكمية الشرش المنفصلة. أما الخواص الحسية من نكهة وقوام ومظهر فقد تحسنت فى كل المعاملات بدرجة ملحوظة عند زيادة نسبة الفاكهة المضافة وكانت أفضل النسب المضافة من الفاكهة ١٥٪ وقد كانت المانجو أكثر الفاكهة تفضيلاً.