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Production of Fruit Flavored Probiotic Rice Milk Beverage

Atwaa, E. H.[1*]; Ahdab A. Elmaadawy[2] and Esraa A. Awaad[2]

[1]Food Science department, Faculty of Agriculture, Zagazig University, Egypt
[2] Department of Home Economics, Faculty of Specific Education, Zagazig University, Egypt

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ABSTRACT

Fruit flavored probiotic rice milk beverages with two different fruit pulp types; mango and papaya at the rate of 10% and 20% were prepared. Fruit flavored probiotic rice milk and plain samples (no fruit pulp added) were analyzed for physicochemical, rheological, microbiological, antioxidant activity and sensory evaluation at fresh and after 5 , 10 and 15 days of storage at refrigerator temperature. The results indicated that total solid, fat and ash content of fruit flavored probiotic rice milk beverages were increased as compared to the plain probiotic rice milk. Also, addition of mango pulp increased fiber content of rice milk beverages, while addition of papaya pulp decreased fiber content of rice milk beverages. However titratable acidity increased with increased fruit pulp percentage. The highest values for viscosity were belonged to probiotic rice milk beverages with 20 % papaya and mango pulp. The counts of *S. thermophilus, L. acidophilus* and *Bifidobacterium bifidum* BB-12 remained above 8 log cfu ml^{-1} at the end of storage period in all treatments. Total phenolic content and radical scavenging activity of probiotic rice milk increased with increased fruit pulp percentage. Fruit flavored probiotic rice milk incorporated with 20 % of mango pulp was the most preferred one as compare to the other treatments for sensory evaluation . The results of current study confirm that, addition of fruit pulp to the probiotic rice milk significantly improved the sensorial acceptability, physico-chemical properties and antioxidant activity of probiotic rice milk beverages.

Keywords: *Oryza sativa* L.; *Mangifera indica L*.; *Carica papaya* ; dairy products; vegetable milk

INTRODUCTION

Most probiotic foods at the markets worldwide are milk based and few attempts are made for development of probiotic foods using other fermentation substrates such as cereals. Their large distribution and important nutritive value have focused the attention on their use as raw materials for the development of new fermented functional foods (Hassan *et al*., 2012).

Vegetable milks are of great interest due to the problems related to intolerance (Fiocchi *et al*., 2010). The nutritional value of rice-based foods could be enhanced through fermentation by amyololytic lactic acid bacteria (LAB) such as some lactobacilli and bifidobacteria strains, which might improve the digestibility of starch in children and increase the availability of lysine (Gobbetti *et al*., 2005; Espirito-Santo *et al*., 2014). The fermented rice extracts with 12 g/100g of waxy maize starch flavored with strawberry syrup and strawberry aroma exhibited high antioxidant capacity, nutritional value, total phenolic compounds (TPC) content, and marketing potential, especially for consumers with special needs, such as those allergic to soybean protein or lactose, as alternative foods ready for consumption (Costa *et al*., 2017).

Rice milk is considered the best hypoallergenic form of milk. It is better to drink rice milk if allergic to soymilk and cow milk. Those with lactose intolerance are advised to drink rice milk since it is cholesterol free with unsaturated fat. The rice milk enhances immune system and provides resistances to bacteria and viruses invading the body due to high content of selenium and magnesium (Belewu *et al*., 2013).

Among the dairy products, fermented products and yoghurt have high digestibility and include starter cultures protecting the microflora, which have inhibitory activities against harmful microorganisms and show anticarcinogenic, antitumor, and anticholesterol traits as well as they might be consumed safely by those with lactose intolerance (Granato *et al*., 2010).

Mango (*Mangifera indica* L) is one of the fruit grown in tropics and is considered as king of the fruits. The nutritional value of 100gm mango fruit is that it provides 17 gm carbohydrates, 0.5 gm protein, 0.27 gm total fat, 0 mg cholesterol and 1.8 gm dietary fibers (Raut *et al*., 2015). Mango is not only easily available and mostly consumed fruits in high amount but also is a rich in lycopene, β- carotene, phenol, anti-oxidants and minerals.(Teshome *et al* .,2017).

Papaya (*Carica papaya*) contains a broad spectrum of phytochemicals including carotenoids, phenolics and glucosinolates (Matter *et al*., 2016). Papaya is a good source of carbohydrates, vitamins and proteins, and mineral elements (Ca, Mg, Na and K) and contains the highest amount of flavonoid and phenol which are beneficial to the body. Ripe papaya is sweet and good for consumption, the unripe papaya is recommended for use due to its nutritive value. (Chukwuka *et al*., 2013). `

The aim of this study was to develop rice probiotic beverage products using commercial probiotic starter culture (ABT-5). As well as to study the effect of mango

* **Corresponding author.**
E-mail address: elsayedhassanattwa@gmail.com
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and papaya pulp addition on some physicochemical, microbiological, nutritional and sensory properties during refrigerated storage.

MATERIALS AND METHODS

Materials:

Rice (*Oryza sativa* L.) Giza 171, Mango (*Mangifera indica* L) and Papaya (*Carica papaya*) were purchased from the local market (Zagazig city, Egypt). ABT-5 culture containing *Lactobacillus acidophilus*, *Streptococcus thermophilus* and *Bifidobacterium bifidum* BB-12 were obtained from Christian Hansen Laboratory (Copenhagen, Denmark). Pure glucose-fructose, 1, 1-diphenyl-2-picrylhydrazyl (DPPH), Gallic acid and other chemicals and reagents were purchased form Sigma-Aldrich (MO,IL USA) .

Methods:

Preparation of rice milk and fruit pulps

Rice milk was prepared according to Hassan *et al* ,(2012), the washed rice was soaking in water for 2 hr, draining, cooking (1:3) /30 min until very soft and blending with water (200 g rice + 400 ml water) ,the blended rice was sieved twice so as to have good texture to give rice milk. Ripe fresh fruits (mango and papaya) were washed with tap water, peeled manually with a knife, and then subjected to pulp extraction. The resulted fruit homogenates were filled into jars, and pasteurized for 15 min at 95°C.

Preparation of probiotic rice milk beverage fortified with fruit pulps:

Rice milk submitted to the fermentation process was enriched with 1.5 % (w/w) glucose-fructose prior to the inoculation process in order to improve the growth and acidification of the mixed culture used, based on previous studies (Bernat *et al*., 2014 and 2015). Rice milk was heated to 90°C for 20 min and then cooled to (37 °C), inoculated with 5% of ABT-5 culture and incubated at 37°C for 16 hr (till pH 4.6), the beverages were put overnight in a refrigerator then stirred and divided into 5 equal portions; the first portion was left without any additives served as a control (C). Pasteurized mango pulp was added to the second and the third portions (T1 and T2) at a rate of 10 and 20 %, respectively. Pasteurized papaya pulp was added to the following two portions (T3and T4,) at a rate of 10 and 20% respectively. fruit flavored fermented rice milk beverages were stored at 4ºC for 15 days; physicochemical, rheological, microbiological, antioxidant activity and sensory evaluation was evaluated at fresh and after 5,10 and 15day intervals.

Chemical analysis

The proximate chemical composition of the samples including total solids (TS), moisture, ash, lipids, crude protein, total acidity (as citric acid) and crud fiber contents, were determined according to AOAC (2010). pH was determined using digital pH meter (Ranganna, 1991). Total carbohydrates were calculated by difference according to Guzman *et al*. (1999), Eq. (1):

$$\textbf{Total carbohydrates} = \textbf{Total Solids (TS)} - \textbf{Fat} + \textbf{Protein} + \textbf{Ash}) \,.$$

Determination of total phenolic content

TPC was determined using Folin-ciocalteau method according to published procedure (Roy *et al*., 2014). Beverage (0.3 mL) was mixed with 0.2 N Folin-Ciocalteu reagents (1.5 mL). After 5 min, 1.2 mL of 0.7N Na_2CO_3 solution added. The mixture was incubated for 2 h at room temperature then the absorbance was recorded at 765 nm, using UV-VIS spectrophotometer (Perkin Elmer Lambda 25 double beam) against a blank sample. Quantitative determinations were carried based on a five-points (10, 25, 50, 75, 100 μg/mL) standard calibration curve of gallic acid dissolved in methanol (80%). The results were expressed as mg galic acid equivalents (GAE)/100 mL beverage.

Procedure

Ten mL of sample was stirred with 10 mL ethanol: water mixture (60:40, v/v) for 30 min at room temperature. The resulted mixture was centrifuged for 15 min at 5000 rpm (Hettig 1004 EBA 21 centrifuge, Germany). The collected supernatant stored at 2°C and used to determine TPC and antioxidant activity of the samples.

Determination of antioxidant activity

The determination of antioxidant activity through DPPH scavenging system was carried out according to the method of Musa *et al*. (2011). Sample (100 μL) was added to 3 mL of 0.1 mM DPPH· dissolved in ethanol and incubated of 60 min at room temperature. The absorbance was recorded against control at 517 nm. Percentage of antioxidant potential of DPPH· was calculated as follows:

$$\textbf{DPPH} \cdot \textbf{ scavenging activity } (\%) = [(\textbf{A0} - \textbf{A1})/\textbf{A0}] \times \textbf{100}$$

Where, A0 is the absorbance of the control, and A1 is the absorbance in the extract. Samples were analyzed in triplicate.

Viscosity

The viscosity was measured according method of **Aryana (2003).** Viscosity of drink sample was determined using Rotational viscometer Type Lab. Line Model 5437. Results expressed as CPS.

Microbiological analysis:

Viable counts were determined in fermented beverages (1 ml), at fresh and after 5and 10 days of storage. Differential media used for enumeration of *S. thermophilus*, *L. acidophilus* and *Bifidobacterium bifidum* BB-12 where those previously described by Martin-Diana *et al*. (2003).

Organoleptic evaluation of prepared product

Prepared beverages were evaluated for organoleptic characteristics according to Farag *et al*., (2007).

Statistical analysis

Experiment was carried out in triplicate and the data were transferred to the SPSS (2007) version 16 program, data was statistically analyzed by using one way ANOVA.

RESULTS AND DISCUSSION

Physicochemical composition of rice milk, mango and papaya pulps:

The physicochemical composition of rice milk, mango and papaya pulps is illustrated in Table (1). Total solids, fat, protein, fiber, ash and carbohydrate contents of rice milk were (12.85, 0.32, 1.78, 1.52, 0.48, and 10.27g/100g respectively. The data of chemical composition of rice milk found in our study were near to those obtained by Abou-Dobara *et al*.(2016) who reported that TS, fat and ash of rice milk were 12.3, 0.3 and 0.39 respectively .

Total solids, fat, protein, fiber, ash and carbohydrate contents of mango pulp were (17.80, 0.36, 0.58, 0.42, 0.54, and16.22 g/100g respectively. These results are in agreement with the data obtained by Elbandy *et al*, (2014) and Elsheshetawy *et al*, (2016).

Total solids, fat, protein, fiber, ash and carbohydrate contents of papaya pulp were (13.42, 0.52, 1.02, 0.82, 0.58 and 11.33 g/100g respectively. These results are in agreement with the data obtained by Nwofia *et al*, (2012) and Matter *et al*,(2016)

Also, Table (1) reveled that, the TPC of rice milk, mango and papaya pulps extracts were 80.62, 2420.80 and 1390.20 mg/100g, respectively. While the RSA (%) of rice milk, mango and papaya pulps extracts were 30.24, 89.60 and 82.50 %. These results agree with that previously reported (Hassan *et al*, 2012 and Walter *et al*, 2013) for rice milk, (Elbandy *et al*, 2014) for mango pulp and (Jin-Sik Nam *et al*, 2019) for papaya pulp.

Table 1. physicochemical composition of rice milk, mango and papaya pulps

Fruit	Total solids %	Fat %	Protein %	Fiber %	Ash %	Carbohydrate %	pH	RSA %	TPC (mg/100g)
Rice milk	12.85±0.18 c	0.32±0.0 6 b	1.78±0.20 a	1.52±0.30 b	0.48±0.03 c	10.27±0.69 c	6.73±0.08 a	30.2±0.78 c	80.62±2.42 c
Mango pulp	17.80±0.32 a	0.36±0.0 8 b	0.58±0.12 c	2.40±0.42 a	0.64±0.06 a	16.22±1.36 a	3.90±0.00 c	89.60±1.30 a	2420.80±7.34 a
Papaya pulp	13.42±0.16 b	0.52±0.12 a	1.02±0.18 b	0.82±0.16 c	.58±0.38 b	11.33±0.98 b	4.92±0.01 b	82.50±1.48 b	1390.20±4.20 b

Values (means ±SD) with different superscript letters are statistically significantly different (*P* ≤ 0.05).

Chemical composition of probiotic beverages samples

Chemical compositions of probiotic rice milk beverages samples are shown in Table 2. Rice milk beverages fortified with 20 % mango pulp (T2) had the highest total solids content. The addition of fruit pulps increased TS, fat, and ash contents of rice milk beverages treatments but decreased protein content this may be due to a high TS, ash and fat contents of fruit pulp .As for as fiber content addition of mango pulp increased fiber content of rice milk beverages, while addition of papaya pulp decreased fiber content of rice milk beverages, this may be due to a high fiber content of mango pulp than papaya pulp and rice milk. These results are in agreement with the data obtained by Matter *et al*, (2016), who found that addition of papaya and cactus pear pulp with different proportions to yoghurt increased TS, fiber, ash and carbohydrate contents compared to control yoghurt and decreased protein and fat content.

Table 2. Chemical composition of probiotic rice milk beverage during storage at refrigerator temperature for 15 day

Parameters	Storage period (Day)	Treatments				
		C	T_1	T_2	T_3	T_4
TS%	Fresh	13.32±0.25^{d}	14.04±0.21^{b}	15.18±0.27^{a}	13.54±0.29^{cd}	13.72±0.23^{c}
	5	13.70±0.23^{d}	14.58±0.29^{b}	15.70±0.21^{a}	13.82±0.30^{d}	14.02±0.28^{c}
	10	13.92±0.21^{d}	15.06±0.23^{b}	16.32±0.22^{a}	14.04±0.25^{d}	14.48±0.23^{c}
	15	14.20±0.29^{d}	15.38±0.24^{b}	16.86±0.25a	14.32±0.27^{cd}	14.56±0.30^{c}
Fat %	Fresh	0.68±0.01^{d}	0.70±0.02^{c}	0.72±0.01^{c}	0.74±0.04^{b}	0.78±0.03^{a}
	5	0.72±0.03^{c}	0.75±0.06^{bc}	0.78±0.04^{bc}	0.80±0.05^{b}	0.86±0.01^{a}
	10	0.78±0.02^{d}	0.82±0.00^{c}	0.85±0.02^{b}	0.84±0.00^{b}	0.90±0.05^{a}
	15	0.80±0.00^{c}	0.85±0.02^{bc}	0.88±0.00^{b}	0.86±0.02^{b}	0.92±0.03^{a}
Protein %	Fresh	2.54±0.07^{a}	2.30±0.05^{c}	2.18±0.03^{d}	2.40±0.06^{bc}	2.45±0.03^{b}
	5	2.60±0.05^{a}	2.35±0.04^{c}	2.25±0.07^{d}	2.48±0.06^{bc}	2.52±0.05^{b}
	10	2.82±0.06^{a}	2.42±0.05^{c}	2.34±0.06^{d}	2.54±0.04^{bc}	2.60±0.06^{b}
	15	2.90±0.04^{a}	2.64±0.03^{c}	2.44±0.04^{d}	2.60±0.07^{bc}	2.66±0.04^{b}
Fiber %	Fresh	1.74±0.01^{c}	1.86±0.05^{b}	1.98±0.01^{a}	1.62±0.06^{d}	1.54±0.03^{e}
	5	1.76±0.04^{c}	1.90±0.03^{b}	2.00±0.03^{a}	1.66±0.05^{d}	1.58±0.06^{e}
	10	1.80±0.02^{c}	1.92±0.04^{b}	2.04±0.05^{a}	1.70±0.03^{d}	1.62±0.05^{e}
	15	1.84±0.06^{c}	1.98±0.01^{b}	2.18±0.02^{a}	1.80±0.04^{d}	1.74±202e
Ash %	Fresh	0.75±0.05^{bc}	0.82±0.06^{b}	0.88±0.02^{a}	0.78±0.11^{bc}	0.82±0.09^{b}
	5	0.78±0.11^{b}	0.85±0.11^{ab}	0.92±0.05^{a}	0.80±0.09^{b}	0.86±0.04^{ab}
	10	0.84±0.08^{b}	0.90±0.04^{ab}	0.96±0.09^{a}	0.82±0.06^{b}	0.92±0.02^{ab}
	15	0.88±0.04^{bc}	0.94±0.05^{b}	1.04±0.07^{a}	0.85±0.07^{bc}	0.98±0.06^{ab}

*** Values (means ±SD) with different superscript letters are statistically significantly different (*P* ≤ 0.05).**

C: probiotic rice milk beverage, T1: probiotic rice milk beverage fortified with 10% mango pulp, T2: probiotic rice milk beverage fortified with 20% mango pulp, T3: probiotic rice milk beverage fortified with 10% papaya pulp , T4: probiotic rice milk beverage fortified with 20% papaya pulp

pH, acidity and viscosity values of probiotic rice milk beverage during storage at refrigerator temperature for 15 day

Table (3) shows that addition of fruit pulp decreased the pH in rice milk beverages, while titratable acidity increased with increased fruit pulp percentage. Titratable acidity increased and pH decreased as storage period progressed. Similar observation was reported by Roy *et al*., (2015) reported that, the acidity of yoghurt was increased with increasing of banana, papaya and watermelon pulps percentages. Also, Aamer *et al*, (2017) found that fortification of functional beverages from whey and permeate with Kumquat fruit increased the acidity of beverages.

The result of this study indicates that, T2 had the highest titratable acidity, but it had lowest pH at the end of storage period.

Fortification of rice milk beverages with fruits pulp significantly increased viscosity compared with control treatment, and this increasing was proportional to the fortification ratio Table (3) .These results might be due to a high content total solids and fat of fruits pulp than rice milk. The viscosity of all treatments decreased as storage period progressed .These result are in agreement with those reported by Matter *et al* (2016) who stated that fortification of yoghurt with papaya and cactus pear pulp increased viscosity of treatments and Aamer *et al*, (2017) reported that, the viscosity of functional beverages from whey and permeate fortified with Kumquat fruit increased with increasing of fruit pulp percentages.

Table 3. pH, acidity and viscosity values of probiotic rice milk beverage during storage at refrigerator temperature for 15 day

Parameters	Storage period (Day)	Treatments				
		C	T_1	T_2	T_3	T_4
pH	Fresh	4.60±0.02^{a}	4.32±0.07^{c}	4.14±0.05^{d}	4.46±0.04^{b}	4.42±0.01^{bc}
	5	4.52±0.04^{a}	4.06±0.03^{c}	3.90±0.02^{d}	4.22±0.05^{b}	4.04±0.07^{c}
	10	4.44±0.07^{a}	3.86±0.04^{d}	3.60±0.03^{e}	4.03±0.02^{b}	3.90±0.05^{c}
	15	4.40±0.01^{a}	3.82±0.04^{c}	3.54±0.08^{d}	3.96±0.07^{b}	3.84±0.03^{c}
Viscosity	Fresh	760±20.0^{cd}	800±22.0^{b}	860±16.0^{a}	780±18.0^{c}	790±20.0^{bc}
	5	740±16.0^{cd}	780±17.0^{b}	820±20^{a}	750±22.0^{c}	770±18.0^{bc}
	10	710±14.0^{cd}	750±18.0^{b}	800±17.0^{a}	720±15.0^{cd}	740±20.0^{bc}
	15	690±13.0^{cd}	730±20.0^{b}	790±18.0^{a}	700±17.0^{c}	730±14.0^{b}
Acidity	Fresh	0.40±0.02^{d}	0.60±04b^{c}	0.74±0.03^{a}	0.56±0.01^{c}	0.64±0.05^{b}
	5	0.62±0.05^{d}	0.90±0.01^{b}	1.00±0.05^{a}	0.78±0.03^{c}	0.92±0.04^{b}
	10	0.80±0.07^{e}	1.08±0.03^{c}	1.40±0.04^{a}	0.94±0.06^{d}	1.20±0.02^{b}
	15	0.92±0.04^{e}	1.26±0.05^{c}	1.64±0.02^{a}	1.08±0.04^{d}	1.42±0.01^{b}

*** Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).**

Total phenolic content and radical scavenging activity of probiotic rice milk beverages during storage period:

Phenolic contents and antioxidant activity probiotic rice milk beverages fortified with mango and papaya pulp are presented in Table 4 There were significant differences in the phenolic contents and antioxidant activity of the samples (P <0.05).Addition of mango and papaya pulps significantly increased phenolic contents and antioxidant activity of probiotic rice milk beverages. The highest value of phenolic contents and antioxidant activity were (240.68 mg /100g and 38.20 %) respectively, at the end of storage period for probiotic rice milk beverages fortified with 20 % mango pulp. These may be due to the high concentrations of vitamin C and other antioxidant compounds of mango pulp (Elbandy *et al* ,2014 and Elsheshetawy *et al* ,2016).these results are agreement with reported by Raut *et al* ,(2015) who found that addition of mango pulp to yoghurt increased the TPC and RSA% of fortified yoghurt.

Table 4. Total phenolic content and radical scavenging probiotic rice milk beverage during storage at refrigerator temperature for 15 day

Treatments	Total phenolic content (mg /100g)				Radical scavenging activity %			
	Storage period (Day)							
	Fresh	5	10	15	Fresh	5	10	15
C	97.55±3.71 e	74.32±4.20 e	66.20±2.99e	40.50±1.55 e	38.20±1.22 e	32.40±0.58e	28.50±0.75e	22.40±0.81e
T_1	220.16±9.99c	180.54±6.53c	160.22±2.0c	130.42±3.71c	46.60±3.17 c	41.20±0.66c	36.70±0.55c	30.50±0.75c
T_2	380.52±6.72a	320.12±9.34a	290.42±9.3a	240.68±5.74a	54.30±4.45 a	49.30±0.90a	44.80±0.84a	38.20±0.58a
T_3	170.20±7.16d	120.36±2.99d	94.80±1.50d	76.32±2.02d	40.70±2.99 d	38.40±0.72d	33.20±0.90d	26.40±0.64d
T_4	250.60±6.30b	210.40±6.30b	170.60±7.1b	140.14±5.42b	48.50±3.89 b	44.30±0.86b	39.50±0.67b	34.60±0.92b

*** Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).**

Microbiological evaluation of probiotic rice milk beverage during storage at refrigerator temperature for 15 day:

Table (5) showed that *Streptococcus thermophilus, Lactobacillus acidophilus* and *Bifidobacterium. bifidum* counts decreased in all treatments up to the end of storage period. Rice milk probiotic beverages treatments fortified with fruit pulps had the lowest *Streptococcus thermophiles, Lactobacillus acidophilus* and *Bifidobacterium. bifidum* counts these may be due to antioxidant and antimicrobial activity of fruit pulp. Also, lactic acid bacteria grow optimally under slightly acidic condition when the pH is between 4.5 and 6.4. In addition to the pH value, concentration of lactose in fruit flavored yoghurt samples may also influence the growth of lactic acid bacteria (Prescott *et al*., 2005). The fortification of rice milk with fruit pulp decreased the viability of *Streptococcus thermophiles, Lactobacillus acidophilus* and *Bifidobacterium bifidum*. Numbers of *S. thermophilus, L. acidophilus* and *Bifidobacterium bifidum* BB-12 remained above 8 log cfu ml^{-1}

Similar results were reported by Bakirci and Kavaz (2008) mentioned that viable counts of *S. thermophilus, L. acidophilus* and Bifidobacterium spp. decreased slightly during the refrigerated storage, but remained at sufficient levels (>6 log cfu/g) for up to 14 days. Also, Abou-Dobara *et al*.,(2016) found that culture bacteria not only were able to grow in soy, peanut or rice milk but also their numbers and viability were higher in them as compared with cow milk .Teshome *et al*.,(2017) ,found that fortification of yoghurt with mango and papaya juices decreased the viability of lactic acid bacteria during storage.

Table 5. Microbiological evaluation of probiotic rice milk beverage during storage at refrigerator temperature for 15 day

Bacterial counts	Storage period (Day)	Treatments				
		C	T_1	T_2	T_3	T_4
S. thermophilus log cfu ml^{-1}	Fresh	9.75	9.62	9.54	9.60	8.50
	5	9.44	9.30	8.99	9.12	8.70
	10	8.32	8.18	8.12	8.44	8.08
	15	8.20	8.06	8.09	8.04	8.00
L. acidophilus log cfu ml^{-1}	Fresh	9.46	9.38	9.20	9.35	9.08
	5	9.10	8.80	8.60	8.65	8.34
	10	8.48	8.26	8.12	8.20	8.07
	15	8.32	8.12	8.04	8.09	8.02
Bifidobacterium Bifidum BB-12 log cfu ml^{-1}	Fresh	9.80	9.56	9.50	9.52	9.46
	5	9.28	9.02	8.94	8.98	8.80
	10	8.60	8.42	8.38	8.34	8.28
	15	8.34	8.12	8.14	8.08	8.06

*** Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).**

Sensory properties of probiotic rice milk beverage during storage at refrigerator temperature for 15 day:

Results in Table (6) reveal that there was significant different between control and the different type of rice milk beverage for overall acceptability, control rice milk beverage had the lowest values ,while rice milk beverage fortified with mango pulp had the highest values. The highest mean value was related to sample containing 20% mango pulp. Storage period had slightly effect on all attributes. According to this result mango pulp rice milk beverage has the most acceptability in point view of consumer. These results are in agreement with those reported by Jayalalitha *et al*, (2015) who found that addition of mango pulp to yoghurt enhanced the sensory evaluations of resultant yoghurt.

Table 6. Sensory properties of probiotic rice milk beverage during storage at refrigerator temperature for 15 day

Sensory criteria	Storage period (Day)	Treatments				
		C	T_1	T_2	T_3	T_4
Flavor (45)	Fresh	39.42±1.32^{c}	41.62±1.40^{b}	43.44±1.66^{a}	39.24±1.15^{c}	38.40±1.55^{cd}
	5	38.54±1.14^{bc}	39.66±1.12^{b}	42.20±1.76^{a}	38.00±1.53^{c}	37.08±1.12^{cd}
	10	35.30±1.50^{c}	37.20±1.27^{b}	39.24±1.43^{a}	35.00±1.53^{c}	33.42±1.45^{d}
	15	32.40±1.60^{c}	34.60±1.34^{b}	37.30±1.20^{a}	33.50±1.71^{bc}	30.80±1.50^{d}
Body & texture (35)	Fresh	32.20±1.50^{bc}	34.30±1.14^{ab}	35.00±1.42^{a}	33.42±1.15^{b}	33.90±1.78^{b}
	5	31.10±1.12^{bc}	33.60±1.45^{ab}	34.20±1.21^{a}	32.28±1.47^{b}	32.50±1.12^{b}
	10	29.40±1.24^{b}	31.42±1.72^{ab}	32.50±1.87^{a}	29.90±1.32^{b}	30.08±1.65^{b}
	15	26.50±1.70^{bc}	28.20±1.55^{ab}	29.70±1.51^{a}	27.30±1.44^{b}	27.40±1.74^{b}
Color& Appearance (10)	Fresh	7.20±0.94^{b}	8.00±0.71^{a}	7.30±0.58^{b}	8.0±0.82^{a}	7.60±0.74^{b}
	5	7.00±0.83^{b}	7.90±0.95^{a}	7.80±0.88^{a}	7.60±0.85^{a}	7.30±0.75^{b}
	10	6.80±0.34^{b}	7.40±0.84^{a}	7.30±0.83^{a}	7.20±0.76^{a}	7.00±0.68^{b}
	15	6.50±0.64^{b}	7.00±0.72^{a}	6.90±0.98^{a}	6.70±0.80^{a}	6.50±0.74^{b}
Acidity taste (10)	Fresh	8.40±0.12^{a}	6.80±0.92^{b}	6.60±0.52^{b}	8.10±0.23^{a}	`8.20±0.33^{a}
	5	8.20±0.44^{a}	6.50±0.65^{c}	6.30±0.58^{c}	7.60±0.68^{b}	8.00±0.12^{a}
	10	8.10±0.63^{a}	6.30±0.22^{c}	6.20±2.12^{c}	7.40±0.83^{b}	7.70±0.23^{ab}
	15	7.90±0.78^{a}	6.00±0.24^{c}	5.80±0.77^{c}	7.00±2.05^{bc}	7.30±0.98^{b}
Overall Acceptance (100)	Fresh	87.22±1.24^{c}	90.72±2.45^{b}	92.34±2.42^{a}	88.76±0.81^{c}	88.10±0.99^{c}
	5	84.84±0.63^{cd}	87.66±0.74^{b}	90.50±0.55^{a}	85.48±1.12^{c}	84.88±2.65^{c}
	10	79.60±0.94^{c}	82.32±1.30^{b}	85.24±0.82^{a}	79.50±2.14^{c}	78.20±1.12^{cd}
	15	73.30±3.14^{bc}	75.80±0.65^{b}	79.70±1.47^{a}	74.50±3.01^{b}	72.70±0.81b^{c}

*** Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).**

CONCLUSION

This study shows a new possibility to make an acceptable fermented probiotic rice milk beverages fortified with mango and papaya pulp which are suitable substrates that's can support high cell viability during cold storage for 15 days for different probiotic strains. In addition these produced beverages combines therefore interesting nutritional qualities and probiotic characteristics. This kind of study can facilitate the development of new, fermented, non-dairy, nutritionally well-balanced food products with unique physical properties.

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انتاج مشروب لبن الأرز الحيوى المنكه بالفاكهة

السيد حسن عطوة [1] ، أهداب عبده المعداوى [2] و اسراء عبدالفتاح عواد[2]

[1]قسم علوم الأغذية -كلية الزراعة - جامعة الزقازيق- مصر

[2]قسم الاقتصاد المنزلى - كلية التربية النوعية- جامعة الزقازيق- مصر

فى هذا البحث تم اعداد مشروب لبن أرز حيوى منكه بنوعين من لب الفاكهة (المانجو والباباز) بمعدلات 10 و 20 % لكل منها وتم تحليل جميع المعاملات فيزوكيميائيا وريولوجيا وبكتريولوجيا وحسيا بعد التصنيع مباشرة وخلال فترة التحزين على درجة حرارة الثلاجة لمدة 15 يوم .ولقد اشارت النتائج الى حدوث زيادة فى محتويات الجوامد الصلبة الكلية والدهن والرماد فى مشروب لبن الأرز الحيوى المدعم بلب الفاكهة مقارنة بمشروب لبن الأرز الحيوى العادى(المقارنة) كما ان اضافة لب المانجو الى مشروب لبن الارز الحيوى زاد من محتوى الالياف الكلية بينما قل محتوى الالياف الكلية لمشروب لبن الارز الحيوى باضافة لب الباباز ,كذلك زادت حموضة مشروب لبن الارز الحيوى نتيجة اضافة لب الفاكهة.ومن حيث اللزوجة اعطى مشروب لبن الأرز الحيوى المحتوى على 20 % لب المانجو اوالباباز أعلى قيمة مقارنة بباقى المعاملات ,كما ان اعداد بكتريا جنس *S. thermophilus, L. acidophilus* and *Bifidobacterium bifidum* BB-12 ظلت اعلى من 8 log cfu ml^{-1} على نهاية فترة التخزين لكل المعاملات ,كما زاد محتوى المواد الفينولية الكلية والنشاط المضاد للأكسدة لمشروب لبن الأرز الحيوى باضافة لب الفاكهة وبزيادة نسبة اللب المضاف وكانت المعاملة المحتوية على 20% لب المانجو هى الافضل مقارنة بباقى المعاملات من حيث التقييم الحسى .وتشير نتائج هذه الدراسة الى امكانية انتاج مشروب لبن أرز حيوى مدعم باضافة لب فاكهة المانجو او الباباز بنسبة 20% حيث حسنت هذه الاضافة من الخواص الحسية والفيزوكيميائية والنشاط المضاد للاكسدة والقيمة الغذائية لمشروب لبن الأرز الحيوى.