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Chemical Composition, Sensory Evaluation and Starter Activity in Cow, Soy, Peanut and Rice Milk

Mohamed Ismail Abou-Dobara[1], Magdy Mohamed Ismail[2, *], Nawal Mohamed Refat[2]

[1]Botany Department, Faculty of Science, Damietta University, Damietta, Egypt

[2]Dairy Technology Department, Animal Production Research Institute, Agricultural Research Center, Dokki, Giza, Egypt

Email address:

magdy250@yahoo.com (M. M. Ismail)

[*]Corresponding author

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Abstract: The aim of this work was to study the effect of mixing various levels of soy, peanut or rice milk with cow milk on the chemical composition, sensory attributes, starter activity and culture bacteria counts during fermentation. The results showed that no clear differences in titratable acidity, pH and redox potential (E_h) values were noticed between cow or soy milk while acidity and E_h levels of peanut and rice milk were lower than those of cow milk. Total solids, fat, total protein and ash concentrations of cow milk were slightly higher than those of soy and rice milk. Peanut milk was richer in fat but poorer in ash than cow milk. Color, appearance, smell, taste, mouth feel, texture and body scores of cow milk were higher than those of soy, peanut or rice milk but rice milk gained the highest scores of color and appearance. Incorporation of cow milk with soy or peanut milk improved its sensory evaluation scores. Both acidity ratios and the development of acidity rates within fermentation were higher in cow milk than that of soy, peanut or rice milk. 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. Furthermore, incorporation of soy, peanut and rice milk with cow milk increased this influence.

Keywords: Soy, Peanut, Rice Milk, ABT, Bifidobacteria

1. Introduction

Soy milk, the water extract of soybean, offers a promising performance as a carrier of probiotics [1]. Furthermore, it is enriched in nutritive elements like proteins, unsaturated fatty acids, lecithins, isoflavones, mineral substances, free amino acids and polypeptides [2], while containing only a small amount of saturated fatty acid and it lacks cholesterol or lactose [3]. Therefore, soymilk and fermented soymilk products considered as suitable economical substitutes for cow's milk and an ideal nutritional supplement for lactose intolerant population [4].

Peanut milk is also highly healthful as that of soybean milk with added advantage of not having strong beany flavour. Peanut milk and peanut milk products have nutritional benefits because of their extreme richness in protein, minerals and essential fatty acids such as linoleic and oleic acids, which are considered to be highly valuable in human nutrition. It is extensively used in India and other developing countries by vegetarians and more recently by children allergic to cow milk proteins [5].

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 [6]. Therefore, the main purposes of this study were to investigate the changes of the chemical composition, sensory evaluation, starter activity and culture bacteria counts during fermentation of cow's milk as a result of addition soy, peanut or rice milk.

2. Material and Methods

2.1. Materials

Fresh cow's milk was obtained from El-Serw Animal Production Research Station, Animal Production Research Institute, Agriculture Research Center. Yellow soybeans (*Glycine max* L), peanut (*Arachis hypogaea* L) and rice (*Oryza sativa*) were purchased from a local grocery in Damiette Governorate. ABT-5 culture which consists of *S. thermophiles*, *Lactobacillus acidophilus* + *B. bifidum* (Chr. Hansen's Lab A/S Copenhagen, Denmark) was used in Raybe production. Starter cultures were in freeze-dried direct-to-vat set form and stored at –18°C until used.

2.2. Methods

2.2.1. Preparation of Soy, Peanut and Rice Milk

Soymilk was prepared as described by Ikya et al., [7] whereas peanut milk was prepared using a method reported by Bensmira and Jiang [8]. Rice milk was prepared using a method reported by Belewu et al., [6].

2.2.2. Methods of Analysis

i. Chemical Analysis

Total solids, fat, total nitrogen and ash contents of milk samples were determined according to AOAC [9]. Titratable acidity in terms of % lactic acid was measured by titrating 10g of sample mixed with 10ml of boiling distilled water against 0.1 N NaOH using a 0.5% phenolphthalein indicator to an end point of faint pink color [10]. pH of the sample was measured at 17 to 20°C using a pH meter (Corning pH/ion analyzer 350, Corning, NY) after calibration with standard buffers (pH 4.0 and 7.0). Redox potential was measured with a platinum electrode [model P14805-SC-DPAS-K8S/325; Ingold (now Mettler Toledo), Urdorf, Switzerland] connected to a pH meter (model H 18418; Hanna Instruments, Padova, Italy).

ii. Sensory Properties Judging

The sensory properties of milk samples were determined by a panel of judges who were familiar with the product using the hedonic scale where 1-10 represents dislike extremely to like extremely [11].

iii. Microbial Analysis

Milk samples were analyzed for *Streptococcus thermophiles* and *Lactobacillus acidophilus* counts according to the methods described by Tharmaraj and Shah [12]. The count of bifidobacteria was determined according to Dinakar and Mistry [13].

3. Results and Discussion

3.1. Physiochemical Composition of Admixture of Cow, Soy, Peanut and Rice Milk

Results in Table 1 indicate the physiochemical composition of cow and soy milk and their mixtures (samples A-E). No significant differences in titratable acidity, pH and redox potential (E_h) values were noticed between various treatments. The acidity contents of cow and soy milk and cow and soy milk mixture (50+50%) were 0.16, 0.17 and 0.16% respectively. Total solids, fat, total protein and ash concentrations of cow milk were slightly higher than those of soy milk. Therefore mixing of the former with the latter increased these contents in the resulted mixtures as compared with soy milk only. On a general note, these findings revealed that chemical characteristics of cow and soy milk mixtures show suitable technological properties. The chemical composition values of soymilk obtained in this study were within ranges described by Sowonola et al., [14] and Sumarna [15] while were higher than recommended by Tunde-Akintunde and Souley [11] and Jiang et al., [16]. Sowonola et al., [14] showed that dry matter, protein, fat and ash contents of soymilk were 11.56, 3.54, 2.60 and 0.89% respectively while Sumarna [15] cleared that total solids and protein values of soymilk were 11.10 and 3.6% respectively. Conversely, Tunde-Akintunde and Souley [11] stated that total solids, protein, fat and ash values of soymilk were 7.98, 2.93, 1.94 and 0.32% respectively. Jiang et al., [16] reported that total solids, protein, fat and ash values of soymilk were 5.86, 2.19, 1.37 and 0.33% respectively. Soymilk composition varies depending on processing conditions and bean variety [17].

Titratable acidity, pH, E_h, total solids, fat, total protein and ash values of peanut milk were presented in Table 1. Acidity and E_h levels of peanut milk were lower while pH values were higher than those of cow milk. Peanut milk presented acidity content of 0.08% and pH value of 7.41, a result close to the one found by Elsamani and Ahmed [18] whereas acidity and pH values of peanut milk were 0.09% and 7.30 respectively. The total solids and protein contents of peanut milk were close to those of cow milk. On contrary, peanut milk was richer in fat but poorer in ash than cow milk. Values of different chemical composition analysis of cow and peanut milk mixtures were at an intermediate position between those of cow milk and peanut milk. On the whole, the chemical composition values of peanut milk obtained in our investigation were similar to those recorded by Isanga and Zhang [19] while were higher than obtained by Giyarto et al., [20] and Albuquerque et al., [21] and lower than showed by Elsamani and Ahmed [18]. Isanga and Zhang [19] reported that TS content of peanut milk was 12.85%. Giyarto et al., [20] cleared that peanut milk contained TS 6.65%, fat 2.69%, protein 2.26%. The respective values obtained by Albuquerque et al., [21] were TS 9.60% and protein 2.46%. Total solids, fat and protein concentrations of peanut milk prepared by Elsamani and Ahmed [18] were 14.70, 5.40 and 5.60% respectively. Generally, the variation in peanut to water ratio used for peanut milk extraction affects the peanut milk composition.

As it is cleared in Table 1, cow milk possessed acidity and E_h levels higher than those of rice milk. Conversely, pH values were lower in the former than that of the latter. Blinding of cow milk with rice milk produced intermediate findings between them.

However total solids content of rice milk was close to that of cow milk, but fat, total protein and ash concentrations were higher in cow milk than those of rice one. Rice milk had very low fat content which didn't exceed 0.3% whereas fat value of cow milk was 3.6%. Increasing of TS content of rice milk might by explained on the basis of high carbohydrate content of rice milk as cleared in literatures. Barka et al., [22] cleared that un-malted brown rice flour had 7.10% protein, 1.26% fat, 1.05% ash, 1.17% fiber and 89.42% carbohydrate. Perezgonzalez [23] showed that the average chemical composition of rice milk is low in protein (0.6%), high in carbohydrate (10.6%) and sugar (4.0%), low in fat (1.0%), low in fiber (0.0%), and within maximum recommended limits for sodium (0.051%).

Generally, the data of chemical composition of rice milk found in our study were near to those obtained by El Tahir [24] who reported that fat, protein, ash and carbohydrate contents of rice milk were 0.18, 1.87, 0.42 and 5.40% respectively. Quite the contrary, Belewu et al., [6] reported very high levels of rice milk components which were 81.25% TS, 0.79% fat, 15.55% protein and 57.30% carbohydrate. These results are related to the rice milk preparation method where rice and water mixture (1:8) was boiled for three hours which of course highly increased the rice milk components.

3.2. Sensory Evaluation of Admixture of Cow, Soy, Peanut and Rice Milk

Table 2 shows the average scores of different sensory attributes of cow milk mixed with different soy, peanut and rice milk concentrations. There were clear differences in the color, appearance, smell, taste, texture, body and mouth feel scores of different treatments. The most obvious differences were found in the smell, taste and mouth feel attributes. However, color and appearance scores of cow milk were higher than those of soymilk but they didn't exceed 8.5 and 9.0 respectively. The white color of buffalo milk is preferred for Egyptian consumers so it is gained the highest color scores comparing with cow milk. Smell, taste and mouth feel grades of soy milk were lower than those of cow milk. Beany taste and flavor undoubtedly are the principal reasons for the declining of soymilk scores. Similar trends were found by EL-Boraey et al., [25].

Because TS, fat and total protein contents were relatively similar in cow and soy milk, texture and body scores of soy milk were slightly low as compared with those of cow milk. On the whole, incorporation of cow milk with soy milk improved its sensory evaluation scores. Saidu [26] reported that soymilk incorporation into numerous foods has been shown to enhance sensory qualities in dairy foods such as yogurt, milk, ice cream, sherbets, etc.

Table 1. *Chemical composition of cow, soy, peanut and rice milk and their mixtures.*

Treatments	Acidity (%)	pH	E_h (mV*)	TS(%)	Fat(%)	TP(%)	Ash (%)
A	0.16	6.64	31.8	12.62	3.6	3.65	0.76
B	0.17	6.62	31.9	11.45	2.6	3.54	0.66
C	0.16	6.63	31.7	12.29	3.4	3.62	0.73
D	0.16	6.64	31.8	12.10	3.1	3.60	0.71
E	0.17	6.61	31.9	11.92	2.9	3.57	0.70
F	0.08	7.41	19.3	11.80	4.5	3.91	0.13
G	0.14	6.77	28.2	12.21	3.9	3.75	0.70
H	0.12	6.82	23.5	12.35	4.2	3.81	0.52
I	0.09	7.28	20.2	11.94	4.3	3.87	0.33
J	0.12	6.75	25.7	12.30	0.3	1.62	0.39
K	0.15	6.67	30.2	12.55	2.8	3.22	0.68
L	0.13	6.69	28.3	12.49	2.1	2.70	0.55
M	0.12	6.72	26.6	12.38	1.1	2.15	0.46

*mV: millivolts
A: Cow milk, B: Soymilk, C: 75% Cow milk + 25% Soymilk, D: 50% Cow milk + 50% Soymilk
E: 25% Cow milk + 75% Soymilk, F: Peanut milk, G: 75% Cow milk + 25% Peanut milk
H: 50% Cow milk + 50% Peanut milk, I: 25% Cow milk + 75% Peanut milk
J: Rice milk, K: 75% Cow milk + 25% Rice milk, L: 50% Cow milk + 50% Rice milk
M: 25% Cow milk + 75% Rice milk

Scores of color and appearance of peanut milk were lower than those of cow milk which may be attributed to the light brown color of peanut. In the same trend, smell, taste and mouth feel scores of peanut milk were lower than those of cow milk. Of course, this was due to the beany taste which wasn't preferred by the majority of panelists. To overcome to this defect, Giyarto et al., [20] added 10% sugar to peanut milk in production of fermented peanut milk drink by *Lactobacillus acidophilus* SNP2.

Because TS content of peanut milk was slightly lower than that of cow milk, scores of texture and body of the former were slightly lower than those of the latter. Mixing of various levels of cow milk with peanut milk highly improved color appearance, smell, taste, texture, body and mouth feel scores. Therefore, it is appropriate to use cow and peanut milk blinds in industrial operations instead of using of peanut milk individually.

The effect of mixing various concentrations of rice milk with cow milk on sensory evaluation scores was stated in Table 2. Rice milk with its intense white gained the highest scores of color and appearance as compared with cow milk with its yellow. Wongkhalaung and Boonyaratanakornkit [27] prepared rice milk by homogenization of saccharified rice contained 17.25% reducing sugars, 3% casein, 3% soybean oil and 0.4% calcium lactate. Lightness of the product was a little lower but it was less greenish and yellowish than that of cow's milk.

Unfortunately, scores of smell, taste and mouth feel of rice milk didn't behave the same trend of color and appearance. Scores of these attributes significantly ($P<0.05$) decreased in rice milk which may be due from one side to the vegetarian grainy taste of rice milk and from other hand to very low fat content. Scores of texture and body of cow and rice milk were close to each other. This may be attributed to the similar results of total solids in both. Blinding of cow milk with rice milk had three effects on sensory evaluation of the resulted mixtures. The first was decreasing of color and appearance grades, the second was improvement of smell, taste and mouth feel scores and the third was no clear effect on texture and body evaluations.

3.3. Changes in Acidity, pH and E_h During Fermentation of Cow, Soy, Peanut and Rice Milk

Increasing of acidity and E_h and decreasing of pH values of milk inoculated with ABT cultures were determined at 30 min intervals during fermentation. Measurements were stopped after 300 min in all of samples. Results were taken as indicator for starter activity in cow, soy, peanut and rice milk and their mixtures.

As noted from Figures 1-9, titratable acidity values increased considerably during fermentation to reach the highest levels at the end of incubation time. The greatest acidity development rates were found after 90 min. Redox potential exhibited the same trend of acidity. Conversely, pH values in samples declined during incubation time. These acidity, E_h and pH changes could be attributed to the number and/or metabolic activity of acid producing micro-organisms. As starter grows, they produce acid which causes an increase in acidity and E_h and a decrease in pH. These results are in agreement with those previously reported for fermented milk "Lebens" [28].

Table 2. *Sensory evaluation scores of cow, soy, peanut and rice milk and their mixtures.*

Treatments	Quality attribute					
	Color	**Appearance**	**Smell**	**Taste**	**Texture& Body**	**Mouth feel**
A	8.50	9.00	9.50	9.50	9.00	9.00
B	7.50	8.00	6.00	6.00	8.55	6.00
C	8.00	8.50	8.00	8.50	8.95	8.50
D	8.00	8.50	7.90	8.35	8.95	8.35
E	7.50	8.00	7.00	7.00	8.85	7.75
F	7.50	8.00	7.50	7.50	8.50	7.50
G	8.00	8.50	8.50	8.50	8.50	8.50
H	8.00	8.50	8.25	8.25	8.50	8.50
I	8.00	8.00	8.00	8.00	8.00	8.25
J	10.00	10.00	9.00	7.50	8.75	7.50
K	8.50	9.00	9.50	9.25	9.00	9.00
L	9.00	9.00	9.25	8.75	9.00	8.75
M	9.50	9.25	9.00	8.25	8.75	8.00

Both acidity ratios and the development of acidity rates within fermentation were a little bit higher in cow milk than that of soy milk (Fig. 1). The drop in pH was faster in the former than in the latter (Fig. 2). As a result of this, mixing of soy milk with cow milk lowered increasing of acidity and E_h in blended milk. These results agreed with Stijepić et al., [29] who cleared that the drop in pH during fermentation was faster in the cow's milk than in soymilk. As far as soymilk is considered, it has the longer time of fermentation compared to cow's milk.

Acidity and E_h values and the increase in both during 300 min of fermentation were very slower in peanut milk than that of cow milk. Also, the reducing in pH was considerably low in peanut milk than that of cow one. Blinding of cow milk with peanut milk improved acidity, E_h and pH changes through fermentation. An increase in the concentration of cow milk positively affected the rate of acid production. This is probably due to that peanut milk is free from lactose [20] or to the nature of protein. These findings are in agreement with the findings of Elsamani and Ahmed [18] who reported that with increasing of skim milk concentrations added to peanut milk, acidity values of yoghurt increased. The acidic nature of powder milk protein could be responsible for high titratable acidities recorded for both samples contained 10 and 15% skim milk (1.59 and 1.78% respectively) when compared with peanut milk sample (0.76%). Acid production in the medium depends on the growth of microorganisms and their ability to ferment the available protein.

However very high carbohydrate content of rice milk, but the acidity, E_h and development acidity rates during fermentation period were slightly lower in rice milk than those of cow milk. Values of pH had the opposite trend for acidity and E_h. This may be attributed to the absence of lactose in rice milk. Similar results were reported in the study of Sirirat and Jelena [30], which cleared that the amounts of lactic acid (g/100g) after 24 and 48h of fermentation were 0.77 and 0.85 in kefir made from cow's milk respectively. The respective values for kefir made from rice milk were 0.49 and 0.76 respectively. These outcomes contradicted with those of El Tahir [24] who showed that the rate of pH decreases at maximum growth at (36h) of strain *B. infantis* 20088 were 1.65 and 0.3 in fermented rice milk and skim milk respectively. As it is shown in Fig. 7, mixing of cow milk with rice milk activated the lactic acid production within fermentation. Mixtures of cow milk with rice milk possessed higher acidity, E_h and development acidity rates and lower pH values of that rice milk. It is clear that cow's milk provided lactose which is the substrate of lactic acid production.

3.4. Changes in Starter Bacteria Count During Fermentation of Cow, Soy, Peanut and Rice Milk

Table 3 shows the effect of adding different levels of soy, peanut and rice milk to cow milk on the counts of *Str. thermophillus*, *L. acidophilus* and *B. bifidum* during fermentation.

Irrespective of bacteria species or milk type, there were increases in the numbers of all mentioned bacteria in different milk treatments with prolongation of fermentation time. Indeed, these increases weren't steady between various samples and fermentation periods. Because it is a sole fermenting organism, *Str. thermophillus* counts were higher than those of *L. acidophilus* and *B. bifidum*. Adversely trend was found with increasing of viability rates during fermentation. The viability rates of *L. acidophilus* and *B. bifidum* were higher than those of *Str. thermophillus*. Viability increasing values were 400, 450 and 440% in sample F for *Str. thermophillus*, *L. acidophilus* and *B. bifidum* respectively.

Culture bacteria not only were able to grow in soymilk but also their numbers and viability were higher in it as compared with cow milk. Furthermore, incorporation of soy milk with cow milk highly increased this influence. The greatest value of starter bacteria viability during incubation time was recorded for mixture of cow and soy milk (50+ 50%). This means that both cow and soy milk complements each other when they use for growth of ABT culture. Viability increasing rates of *Str. thermophillus* were 400, 420, 420, 433 and 414% for treatments A, B, C, D, and E respectively. Respective values for *L. acidophilus* were 400, 466, 475, 475 and 420% while were 433, 475, 500, 500 and 450% for *B. bifidum* respectively. This is in close agreement with the report of Scalabrini et al., [31] who showed that bifidobacteria can be used for biotechnological processes that employ soymilk as the substrate. Hassanzadeh-Rostami et al., [32] showed that *L. acidophilus* La-5 showed the greatest ability to grow in cow milk mixed with 20, 40 or 60% soy milk as compared with cow milk alone.

However, soy milk samples contained the highest counts of culture bacteria but had lower development of acidity rates within fermentation than those of cow milk treatments (Fig 1). This inconsistency was explained by Liu [33] who mentioned that lactic acid bacteria grew well in soymilk but produce less organic acids. The low levels of organic acid concentrations in fermenting soymilk presumably encouraged cell growth.

Counts of three species of starter bacteria were higher in peanut milk than that of cow milk. Consequently, viability increasing values were also higher in the former than that of the latter. Unexpectedly, mixing of 25 or 50% cow milk with peanut milk rose both culture bacteria numbers and rates of viability increasing during fermentation. Based on these results it is clear that cow milk supported peanut milk in culture bacteria activation. Viability increasing rates of *Str. thermophillus* were 400, 400, 400 and 433% for treatments F, G, H, and I respectively. Respective values for *L. acidophilus* were 450, 400, 467 and 475% while were 440, 380, 442 and 450% for *B. bifidum* respectively. Kabeir et al., [34] stated that there were significant ($p<0.05$) increases in *B. longum BB536* viable count by extended fermentation period in peanut and cow milk. The rate of *B. longum BB536* increases in peanut and cow milk were 3.15 and 2.89 CFU/ml respectively. These variations in growth could be attributed to variances in availability of nutrients required for growth in different fermented beverages. Peanut contains almost the essential nutrient for strain growth.

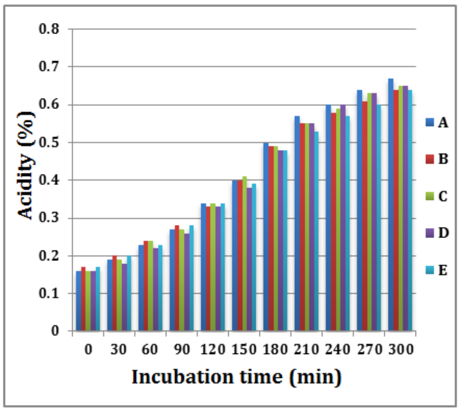

Figure 1. *Changes in acidity of cow and soy milk.*

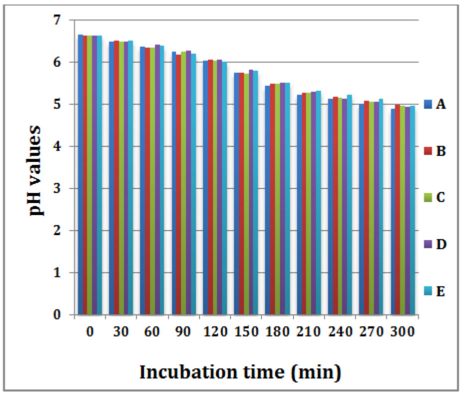

Figure 2. *Changes in pH values of cow and soy milk.*

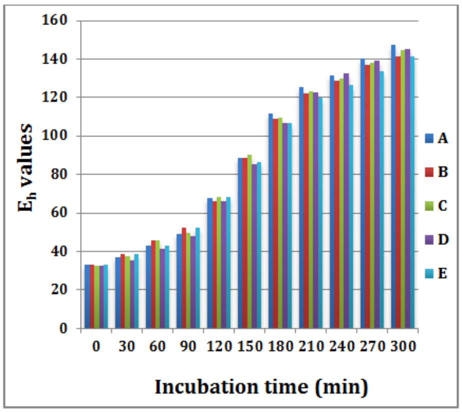

Figure 3. *Changes in E_h of cow and soy milk.*

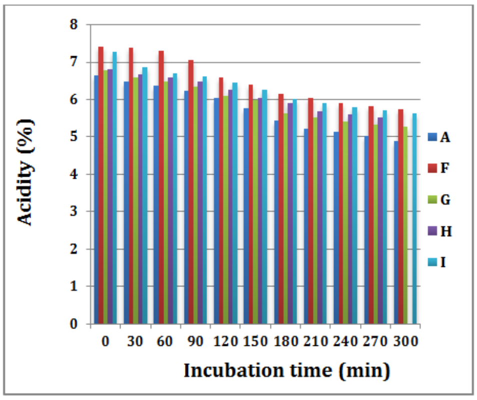

Figure 4. *Changes in acidity of cow and peanut milk.*

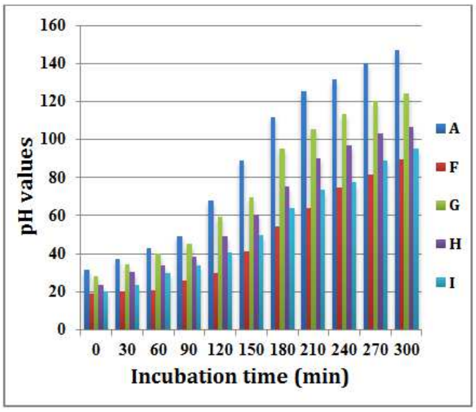

Figure 5. *Changes in pH values of cow and peanut milk.*

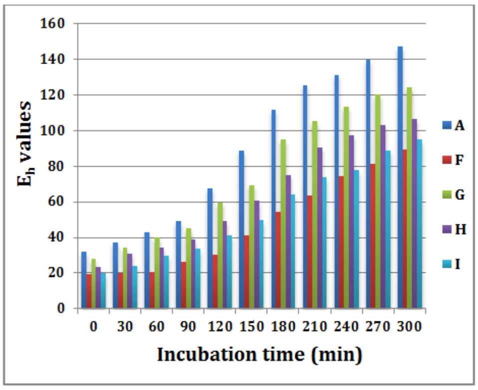

Figure 6. *Changes in E_h of cow and peanut milk.*

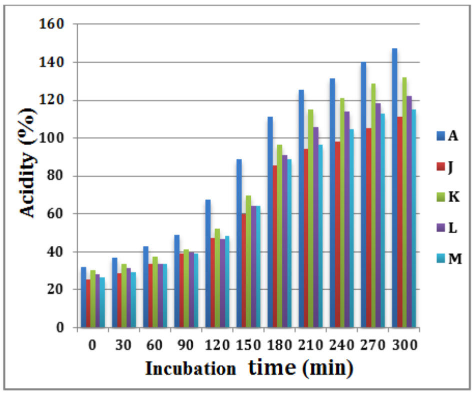

Figure 7. *Changes in acidity of cow and rice milk.*

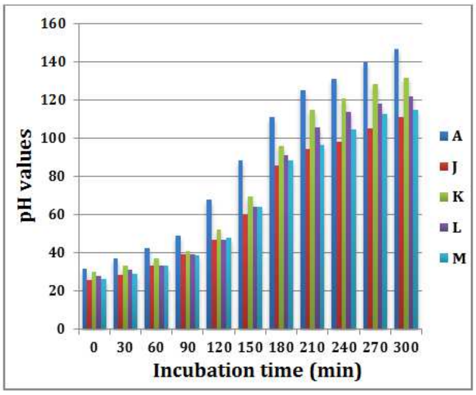

Figure 8. *Changes in pH values of cow and rice milk.*

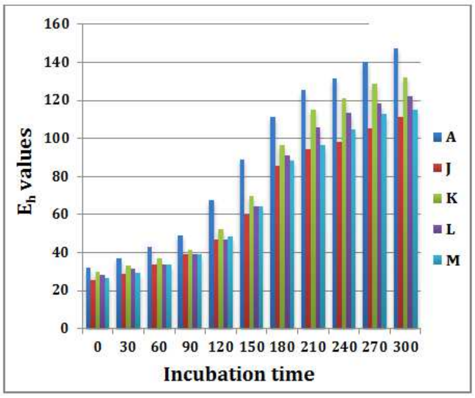

Figure 9. *Changes in E_h of cow and rice milk.*

Comparing between results of Tables 2 and those illustrated in Fig. 4, 5 and 6, it can be observed that however peanut milk inoculated with starter had very low acidity during fermentation but also contained high counts of culture bacteria than that of cow milk which showed high acidity content. This can be explained by the high acid production of starter bacteria in cow milk affect the growth and activity of lactic acid bacteria and bifidobacteria while low acid content and the rich of nutritional components of peanut milk stimulate these bacteria. Supported this point of view, Wang et al., [35] cleared that the viable populations of *bifidobacterium* and *lactobacillus* tent to decline in fermented soymilk held at 25°C, due to acids accumulation and low tolerance of some probiotics to the acidic environment.

Incorporation of rice milk with cow milk clearly affected the counts of culture bacteria and viability increasing rates. During fermentation, rice milk or rice milk mixed with cow milk had higher numbers of *Str. thermophillus*, *L. acidophilus* and *B. bifidum* as compared with cow milk. Also, viability increasing rates increased in rice milk and raised more by mixing cow milk with rice milk. Viability increasing rates of *Str. thermophillus* were 400, 440, 414 and 428% for treatments J, K, L, and M respectively. Respective values for *L. acidophilus* were 450, 400, 433 and 425% while were 450, 440, 450 and 444% for *B. bifidum* respectively. Hagiwara et al., [36] and Tian et al., [37] reported that levels of nutrients and bioactive compounds in germinated rice. These compounds include proteins, amino acids, sugars, vitamins, gamma-oryzanol, gamma-aminobutyric acid (GABA), tocotrienols and tocopherols and other phytochemical substances. Some of these compounds may promote the growth of probiotic bacteria.

However, high counts of culture bacteria in fermented rice milk samples, the acidity percentages and rates of acidity development were low in these treatments comparing with those of fermented cow milk. That could be due to the high acids production and accumulation in cow milk samples or reduction of availability of nutrient required for the growth as stated by Kabeir et al., [38].

Table 3. *Starter bacteria count of cow and soy milk during fermentation.*

Properties	Treatments	Incubation time (min)	
		30	300
Streptococcus thermophillus (cfu×x10^7/g)	A	4	20
	B	5	26
	C	5	26
	D	6	32
	E	7	36
	F	5	25
	G	5	25
	H	6	30
	I	6	32
	J	8	40
	K	5	27
	L	7	36
	M	7	37
Lactobacillus acidophilus (cfu×x10^5/g)	A	2	10
	B	3	17
	C	3	17
	D	4	23
	E	5	26
	F	2	11
	G	3	15
	H	3	17
	I	4	23
	J	2	11
	K	3	15
	L	3	16
	M	4	21
Bifidobacterium bifidum (cfu×x10^3/g)	A	3	16
	B	4	23
	C	3	18
	D	4	24
	E	6	33
	F	5	27
	G	5	24
	H	7	38
	I	8	44
	J	6	33
	K	5	27
	L	8	44
	M	9	49

4. Conclusion

Mixtures of 50% cow milk +50% soymilk or 50% peanut milk or 50% rice milk gained the best chemical composition, sensory evaluation scores and starter activity values of cow, soy, peanut and rice milk admixtures which could be used in manufacturing of fermented dairy products.

References

[1] Y. Shimakawa, S. Matsubara, N. Yuki, M. Ikeda and F. Ishikawa “Evaluation of *Bifidobacterium breve* strain Yakult-fermented soymilk as a probiotic food,” Int. J Food Micro, vol. 81, pp. 131-136, 2003.

[2] M. Yang and L. Li “Physicochemical, textural and sensory characteristics of probiotic soy yogurt prepared from germinated soybean. Food Technol,” Biotechnol, vol. 48, pp. 490–496, 2010.

[3] Y. C. Wang, R. C. Yu, H. Y. Yang and C. C. Chou “Sugar and acid contents in soymilk fermented with lactic acid bacteria alone or simultaneously with bifidobacteria,” Food Micro, vol. 20, pp. 333-338, 2003.

[4] Y. H. Pyo and S. M. Song “Physicochemical and sensory characteristics of a medicinal soy yogurt containing health-benefit ingredients,” J. Agric. Food Chem, vol. 57, pp. 170-175, 2009.

[5] K. Diarra, Z. G. Nong and C. Jie “Peanut milk and peanut milk based products production: a review,” Critical Review in Food Sci. and Nut., vol. 45, pp. 405- 423, 2005.

[6] M. A. Belewu, K. O. Abdulsalam, K. Belewu and N. Belewu “Rice- Coconut Yoghurt: Preparation, Nutritional and Sensory Qualities,” Asian J Agri and Rural Development, vol. 3, pp. 924-928, 2013.

[7] J. K. Ikya, D. I. Gernah, H. E. Ojobo and O. K. Oni “Effect of cooking temperature on some quality characteristics of soy milk,” Advance J of Food Sci. and Tech., vol. 5, pp. 543-546, 2013.

[8] M. Bensmira and B. Jiang “Rheological characteristics and nutritional aspects of novel peanut based kefir beverages and whole milk kefir,” Inter. Food Res. J, vol. 19, pp. 647-650, 2012.

[9] AOAC. Association of Official Analytical Chemists. Official Methods of Analysis. 17^{th} ed, Washington, DC, USA, 2000.

[10] R. Parmar “Incorporation of acid whey powders in probiotic yoghurt,” M. Sc. Thesis, Major in Biological Sciences, Specialization in Dairy, South Dakota State University, USA, 2003.

[11] T. Y. Tunde-Akintunde and A. Souley “Effect of processing methods on quality of soymilk,” Pakistan J Nut, vol. 8, pp. 1156-1158, 2009.

[12] N. Tharmaraj and N. P. Shah “Selective Enumeration of *Lactobacillus delbrueckii* ssp. *bulgaricus, Streptococcus thermophilus, Lactobacillus acidophilus*, Bifidobacteria, *Lactobacillus casei, Lactobacillus rhamnosus*, and Propionibacteria,” J. Dairy Sci., vol. 86, pp. 2288–2296, 2003.

[13] P. Dinakar and V. V. Mistry “Growth and viability of *Bifidobacterium bifidum* in Cheddar cheese,” J. Dairy Sci., vol. 77, pp. 2854-2864, 1994.

[14] O. A. Sowonola, T. Y. Tunde- Akintunde and F. Adedeji “Nutritional and sensory qualities of soymilk-kunnu blends, African J Food and Nutritional Sciences,” vol. 5, pp. 1-12, 2005.

[15] Sumarna "Changes of raffinose and stachyose in soy milk fermentation by lactic acid bacteria from local fermented foods of Indonesian," Malaysian J Micro., vol. 4, pp. 26-34, 2008.

[16] S. Jiang, W. Cai and B. Xu "Food quality improvement of soy milk made from short-time germinated soybeans," Foods, vol. 2, pp. 198-212, 2013.

[17] R. Lakshmanan, M. De Lamballerie and S. Jung "Effect of Soybean-to-Water Ratio and pH on Pressurized Soymilk Properties," J Food Sci., vol. 71, pp. E384-E391, 2006.

[18] M. O. Elsamania and I. A. M. Ahmed "Physicochemical characteristics and organoleptic properties of peanuts milk-based yoghurt fortified with skimmed milk powder," J Research in Applied sciences, vol. 1, pp. 68-72, 2014.

[19] J. Isanga and G. Zhang "Production and evaluation of some physicochemical parameters of peanut milk yoghurt," Lebensm. Wiss. Technol., vol. 42, pp. 1132–1138, 2009.

[20] Giyarto, T. F. Djaafar, E. S. Rahayu and T. Utami "Fermentation of peanut milk by *Lactobacillus acidophilus* SNP-2 for production of non-dairy probiotic drink," The 3rd International Conference of Indonesian Society for Lactic Acid Bacteria (3rd IC-ISLAB), 21-22 January, Yogyakarta, Indonesia, 2011.

[21] E. M. B. Albuquerque, F. A. C. Almeida, J. P. Gomes, N. M. C. Alves and W. P. Silva "Production of ''peanut milk'' based beverages enriched with umbu and guava pulps. J the Saudi Society of Agricultural Sciences," vol. 14, pp. 61–67, 2015.

[22] M. K. Barka, S. Mustafa, M. Kharidah, A. A. Suraini and M. Y. Abdul "A nutritious medida (sudanese cereal thin porridge) prepared by fermenting malted brown rice flour with *Bifidobacterium longum* BB 536," Malaysian J Nutrition, vol. 10, pp. 183-193, 2004.

[23] J. D. Perezgonzalez "Nutritional balance of rice milk," J Knowledge Advancement & Integration (ISSN 1177-4576), 2011, 87-90, 2008.

[24] H. M. El Tahir Limia "Microbiological and physiochemical study on *Bifidobacterium infantis* 20088 fermented peanut milk and rice milk and their blends," M. Sc. Thesis, College of Graduate Studies, Sudan University of Science& Technology, 2015.

[25] N. A. EL-Boraey, M. M. Ismail, F. A. Hoda Elashrey "Chemical composition, sensory evaluation, rheological properties and starter activity of admixtures of buffalo's, cow's and soymilk," American J Food Sci. and Nut. Res., vol. 2, pp. 119-127, 2015.

[26] E. P. Saidu Janette "Development, evaluation and characterization of protein-isoflavone enriched soymilk," Ph. D. Thesis, the Department of Food Science, the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College, 2005.

[27] C. Wongkhalaung and M. Boonyaratanakornkit "Development of a yogurt-type product from Saccharified rice," Kasetsart J Natural Sci., vol. 34, pp. 107–116, 2000.

[28] N. Benkerroum and A. Y. Tamime "Technology transfer of some Moroccan traditional dairy products (*lben*, *jben* and *smen*) to small industrial scale," Food Micro., vol. 21, pp. 399–413, 2004.

[29] M. Stijepić, J. Glušac, D. Durđević-Milošević and D. Pešić-Mikulec "Physicochemical characteristics of soy probiotic yoghurt with inulin additon during the refrigerated storage," Romanian Biotechnological Letters, vol.18, pp. 8077-8085, 2013.

[30] D. Sirirat and P. Jelena "Bacterial inhibition and antioxidant activity of kefir produced from Thai jasmine rice milk," Biotechnology, vol. 9, pp. 332-337, 2010.

[31] P. Scalabrini, M. Rossi, P. Spettoli and D. Matteuzzi "Characterization of *Bifidobacterium* strains for use in soymilk fermentation," Int. J. Food Microbiol, vol. 39, pp. 213-219, 1998.

[32] Z. Hassanzadeh-Rostami, S. M. Mazloomi, S. Rahmdel and A. Kazemi "Mixtures of soy- and cow's milk as potential probiotic food carriers," J. Biology and Today's World, vol. 4, pp. 29-33, 2015.

[33] K. Liu "Soybeans: Chemistry, Technology, and Utilization," Chapter 4. I: Soymilk & II: Tofu. New York: Chapman and Hall. p. 138-197, 1997.

[34] B. M. Kabeir, S. E. Ibraheem, H. Limia Mohammed and B. T. Bhagiel, Roasted peanut milk partially substituted with millet thin porridge as a carrier for *Bifidobacterium longum* BaB536," Int. J Current Microbiology and Applied Science, vol. 4, pp. 299-308, 2015.

[35] Y. Wang, R. Yu and C. Chou "Growth and survival of bifidobacteria and lactic acid bacteria during the fermentation and storage of cultured soymilk drinks," Food Microbial, vol. 19, pp. 501- 508, 2002.

[36] H. Hagiwara, T. Seki and T. Ariga "The effect of pre-germinated brown rice intake on blood glucose and PAI-1 levels in streptozotocin-induced diabetic rats," Biosci. Biotechnol. Biochem, vol. 68, pp. 444-447, 2004.

[37] S. Tian, K. Nakamura and H. Kayahara "Analysis of phenolic compounds in white rice, brown rice and germinated brown rice," J. Agric. Food Chem, vol. 52, pp. 4808-4813, 2004.

[38] B. M. Kabeir, S. Abd Aziz S, M. Muhamed and A. M. Yazid "Growth of *Bifidobacterium longum* BB536 in Media (fermented cereal porridge) and their survival during storage," Let. Appl. Microbial, vol. l41, 12-131, 2005.