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Sensory and Nutritional Evaluation of Coconut-Natural Milk Blend

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Abstract

Coconut milk was prepared by grinding coconut with water and straining through muslin cloth. To improve total solids and protein contents of coconut milk, various temperatures and pH levels of extraction water were investigated. Coconut milk prepared by grinding coconut with hot water (80°C) at pH 8 contained highest solids and proteins. The coconut milk was then blended with various percentages of skim milk powder. These coconut-natural milk blends were subjected to sensory evaluation. It was found that coconut milk blended with 15% skim milk powder on total solids basis was most liked by the judges. Further, for nutritional evaluation, the coconut-natural milk blended with 15% skim milk powder was compared with cow milk. The results showed that this blend had slightly low protein and fat contents, while it contained more ash. Ca and Na were found less while Mg, K and Fe were more in coconut-natural milk blend than cow milk.

Keywords: Coconut-natural milk, Skim milk, Nutritional evaluation, Chemical composition, Sensory characteristics.

Introduction

Coconut (*Cocus nucifera)* is the stone of the drupes borne by the coconut palm, a member of the monocotyledonous family Palmae. It is known as the "wonder food" and is regarded as perfect diet because it contains almost all essential nutrients needed by the human body. It is nourishing, strengthening and fattening food. It has high oil content. The protein is of high quality and contains all amino acids essential for the growth and maintenance of the body. It is rich in K, Na, Mg and S. The energy value of the dried coconut is 662 calories per 100 g (Bakhru, 2000).

Coconut milk, the oil-protein-water emulsion obtained when the freshly grated meat (endosperm) is squeezed through a muslin cloth, is a well known product in areas that grow coconut.

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The consistency of this milk varies considerably depending on quantity of water added during the process. Quite often, it is customary to repeat the operation two or three times, each time obtaining a more dilute emulsion. Although, Increase in temperature of water during extraction does not have positive effect but the repeated extractions increase the quantity of milk by 11.01% (Anjaya *et al.*, 1996). Coconut milk is also an intermediate in the preparation of coconut oil in some rural areas, notably in Indonesia (Grimwood, 1975).

Coconut milk may be considered as a substitute for cow milk. It may be used by the people who cannot tolerate cow milk. The milk of fresh coconut serves as a valuable food for children suffering from nutritional deficiency. It has more vitamin A content than the coconut itself and has adequate minerals.

The total production of the coconut in the world is about 35 million tons. In Pakistan, it is estimated that more than 15,000 scattered plants exist in and around Karachi and other coastal areas of Sindh and Baluchistan (Sharif and Ahmad, 1980).

Keeping the above in view, this study was planned to prepare coconut-natural milk blend with the following objectives:

1. To undertake the physico-chemical analyses of coconut and coconut-natural milk blend.
2. To determine the acceptability of coconut milk blend through sensory evaluation.
3. To determine the mineral elements (Ca, Mg, Na, K, and Fe) of coconut-natural milk blend.

Materials and Methods

Skim milk powder and fresh coconut were purchased from local market. Coconut was analyzed according to the methods of AOAC (2000) for moisture, ash, crude protein, crude fat, crude fibre and nitrogen free extract (NFE).

Preparation of Coconut Milk

Preliminary studies were conducted to select the best temperature and pH levels of extraction water used for grinding coconut. Water at temperatures 40, 50, 60, 70 and 80°C was used at pH 5, 6, 7, 8 and 9. This gave a total of 25 treatments. The pH was adjusted by using citric acid and $NaHCO_3$. In each treatment,

coconut was ground with water in a ratio of 1:2 (coconut: water) in an osterizer. Each sample so obtained was passed through muslin cloth.

The milk obtained was boiled for 2 minutes and then cooled in a closed vessel at 4 ^{o}C for one hour. Fat layer was removed from its surface. The milk was homogenized and total solids and protein content were determined. The milk was evaluated for taste and flavour on 9-point Hedonic Scale by a panel of five judges (Land and Shepherd, 1988). The data was subjected to statistical analysis (Steel *et al*., 1996) and the best temperature and pH level that yielded highest total solids and protein were selected for further investigations.

Blending Coconut Milk with Skim Milk Powder

After preparing the coconut milk, skim milk powder was added in different ratios as given in Table 1.

Table 1: Proportion of skim milk powder and coconut milk to prepare the blend.

Treatments	Coconut milk (%)	Skim milk powder (%)
T1	100	0
T2	95	5
T3	90	10
T4	85	15
T5	80	20

Comparison between Coconut-natural Milk Blend and Cow Milk

Coconut milk, natural and the coconut-natural milk blend were analyzed for protein, fat, ash, acidity, specific gravity, pH and mineral elements (Na, K, Fe, Mg and Ca) according to standard AOAC (2000) methods. Sensory evaluation of these milk samples for colour, flavour, taste and overall acceptability was also carried out according to Land and Shepherd (1988). The data was analysed statistically (Steel *et al*., 1997)

Results and Discussion

Chemical Analysis of Coconut

Fresh coconut was analyzed for proximate composition (Table 2) Fresh coconut contains fat 36.2%, protein 6.1%, ash 1.6%, crude fibre 3.1%, moisture 43.8% and NFE 9.2%.

Table 2: Proximate composition of fresh coconut.

Chemical Constituents	%age
Fat	36.2
Protein	6.1
Ash	1.6
Crude Fibre	3.1
Moisture	43.8
NFE	9.2

The results of proximate composition agree with the findings of Robinson (1969) and Bae *et al*. (1995). Some differences in protein and fibre contents were found which might be due to different areas and conditions of growth.

Selection of Suitable Temperature and pH Level of Water for Grinding Coconut

Trials were conducted to select the best temperature and pH of water required to extract coconut milk. The selection was based on total solids and protein content of milk. The results are given in Table 3.

The data reveals that highest mean value (7.05%) was obtained by T4, while lowest (5.95%) was obtained by T1. Analysis of variance shows that replications are non-significant while treatment means are highly significant. DMR test reveals that T4 and T5 are significant to each other. Hagenmaier *et al*. (1973) used hot water at 80^{o}C for preparation of coconut milk. The present study indicates that water at 80^{o}C is most suitable for extracting maximum total solids from coconut.

The data obtained regarding the effect of pH on total solids indicates that highest mean value was obtained by T4 (10.15%) and lowest by T1 (6.35%). The mean value regarding protein content was highest, obtained by T4 (3.12%) and lowest by T1 (1.8%), whereas T4 and T5 were found almost similar in respect to both the parameters.

The results show that with an increase in pH of grinding water, protein and proportionately total solids content of coconut milk has also increased. Similar results were reported by Khaund (1971), who studied the separation of coconut protein isolates. He used water with high pH to precipitate and separate protein. Irfan (1993) and Rehman *et al.*, (2003) also found that protein in groundnut milk was more when it was prepared by treating groundnut with $NaHCO_3$ solution. It may be concluded that the water with a 80^{o}C and pH of 8.0 is the best for extraction of maximum total solids from coconut.

Preparation of Coconut Milk

Coconut milk was prepared by using water at pH 8.0 at 80^{o}C. A blend was prepared in an osterizer by adding water at coconut-water ratio of 1:2, followed by passing through homogenizer.

Acceptability of the Coconut-natural Milk Blend

The effect of addition of skim milk powder in coconut milk was analyzed through sensory parameters using Hedonic Scale. The scores given by the judges to the coconut-natural milk blended with various percentages of skim milk powder are given in Table 4. The results show that highest mean value was obtained by blend with 15% skim milk, whereas that containing 0% skim milk was awarded lowest scores. The Analysis of Variance data (Table 4) show that the judges are statistically non-significant,

whereas, the treatments are highly significant to each other with respect to colour flavour, taste and overall acceptability of coconut-natural milk blend.

Coconut-natural Milk Blend and Cow Milk

a. Physico-chemical characteristics

Cow milk and coconut-natural milk blend were analyzed for physico-chemical characteristics (Table 5). The results show that coconut-natural milk blend has protein 3.20%, fat 2.36%, acidity 0.18% and specific gravity 1.01 while cow milk contains protein 3.40%, fat 3.82%, acidity 0.21% and specific gravity 1.03. The ash and pH of coconut-natural milk blend were 0.81 and 6.71 respectively that was higher than cow milk. Similarly, K, Mg and Fe were more (196.0, 21.0 and 0.73 mg/100mL respectively) in coconut-natural milk blend while Ca (56.0 mg/ 100mL) and Na (52.0 mg/ 100mL) were found lower than cow milk.

b. Sensory evaluation

The scores given by the judges to coconut- natural milk blend and cow milk for colour, flavour, taste and overall acceptability are given in Table 6.

1. Colour

The results indicate that cow milk obtained a score of 9.00 and coconut-natural milk blend obtained 7.40. Analysis of variance results show that the non-significant difference in the opinion of judges exist, while sample means are highly significant to each other.

2. Flavour

The scores given by the judges to coconut-natural milk blend and cow milk for flavour are given in Table 6. The results show that all the judges have the similar opinion and consider flavour of coconut-natural milk better than cow milk with mean score values of 8.4 and 7.20, respectively. This might be due to the preference of coconut flavour which was felt pleasant and attractive to the judges.

3. Taste

The scores given by the judges to the coconut-natural milk blend and cow milk indicate that the taste of coconut-natural milk blend was good having mean score value of 7.00 and cow milk as very good with mean score of 8.80. The judges rated cow milk superior than coconut-natural milk blend. This is natural since the judges are accustomed to the taste of cow milk.

Overall acceptability

The results of scores awarded and analysis of variance showed that all the Judges have the same opinion about overall acceptability of coconut-natural milk blend and cow milk. They ranked the coconut-natural milk blend better having mean scores of 8.60 to cow milk with mean score of 7.00. The judges rated the coconut-natural milk blend as superior to the cow milk. Although the judges are not use to coconut drink but preferred it over cow milk due to mild coconut flavour

Conclusion

It is concluded from this study that coconut milk extracted with water at 80^{o}C and having pH of 8 was yielded milk with highest total solids. Addition of 15% skim milk powder to coconut-natural milk blend improved the sensory and nutritional qualities of the product.

Table 3: Effect of different temperatures and pH values of the grinding water on total solids and protein content of coconut milk.

No. of Replications	T1	T2	T3	T4	T5	F-values
	Effect of different water temperatures on total solids of coconut milk.					
R1	6.00	6.30	6.60	7.00	7.00	0.2857^{NS} for replications
R2	5.90	6.20	6.60	7.10	7.00	386.9997**
R3	5.95	6.25	6.60	7.05	7.00	for treatments
Means	5.95a	6.25a	6.60ab	7.05b	7.00c	
	Effect of various pH levels of water on total solids of coconut milk at 80 ^{o}C.					
R1	6.40	6.70	7.00	10.15	10.10	0.642^{NS} for replications
R2	6.30	6.60	7.10	10.10	10.10	6144.6385**
R3	6.35	6.65	7.05	10.15	10.10	for treatments
Means	6.35b	6.65b	7.05b	10.15a	10.10a	
	Effect of various pH levels of water on protein contents of coconut milk at 80 ^{o}C.					
R1	1.70	1.90	2.28	3.12	3.14	0.006^{NS} for replications
R2	1.90	2.10	2.42	3.12	2.96	146.66**
R3	1.80	2.00	2.30	3.12	3.10	for treatments
Means	1.80b	2.00b	2.33b	3.12a	3.06a	

Mean values sharing same letters are non-significant to each other.

Table 4: Effect of addition of skim milk powder on sensory characteristics of coconut-natural milk. blend.

	Number of Treatments					
	To	T1	T2	T3	T4	F- values
No. of Judges	Effect on the colour of coconut-natural milk blend					
1	6.00	7.00	8.00	9.00	6.00	0.4156^{NS} for judges
2	7.00	6.00	7.00	9.00	7.00	12.8839**
3	6.00	7.00	6.00	8.00	7.00	for treatments
4	6.00	7.00	8.00	9.00	6.00	
5	7.00	7.00	7.00	9.00	6.00	
Means	6.40c	6.80b	7.20b	8.80a	6.40c	
	Effect on the flavour of coconut-natural milk blend					
1	6.00	5.0	7.00	8.00	7.00	0.7727^{NS} for judges
2	5.00	6.0	7.00	8.00	6.00	14.4091**
3	5.00	6.0	6.00	9.00	8.00	for treatments
4	6.00	7.0	6.00	9.00	7.00	
5	5.00	6.0	7.00	8.00	6.00	
Means	5.40a	6.0bc	6.60b	8.40a	6.80b	
	Effect on the taste of coconut-natural milk blend					
1	6.00	6.00	7.00	9.00	7.00	0.6575^{NS} for judges
2	6.00	7.00	8.00	9.00	7.00	18.1918**
3	5.00	8.00	7.00	8.00	7.00	for treatments
4	6.00	6.00	8.00	9.00	8.00	
5	5.00	7.00	7.00	9.00	7.00	
Means	5.60c	6.80b	7.40b	8.80a	7.20b	
	Effect on the overall acceptability of coconut-natural milk blend					
1	6.00	7.00	8.00	9.00	8.00	3.6712^{NS} for judges
2	6.00	6.00	7.00	9.00	8.00	16.5479**
3	5.00	6.00	7.00	8.00	7.00	for treatments
4	6.00	5.00	6.00	9.00	7.00	
5	7.00	6.00	7.00	9.00	8.00	
Means	6.00b	6.00b	7.00b	8.80a	7.60b	

Mean values sharing same letters are non-significant to each other.

Table 5: Physico-chemical analyses of coconut-natural milk blend and cow milk.

Parameters	Coconut-natural milk blend	Cow milk
Protein (%)	3.20	3.40
Fat (%l)	2.36	3.82
Ash (%l)	0.81	0.70
pH	6.71	6.60
Acidity (%)	0.18	0.21
Specific gravity	1.01	1.03
Ca (mg/100 ml)	56.0	120.0
K (mg/100 ml)	196.0	139.0
Mg (mg/100 ml)	21.0	13.0
Na (mg/100 ml)	52.0	72.0
Fe (mg/100 ml)	0.73	0.40

Table 6: Comparison of coconut-natural milk blend and cow milk for colour, flavour, taste and overall acceptability.

	Number of Judges					Means	F-values
	1	2	3	4	5		
	Colour						
Coconut-natural milk blend	8.00	7.00	8.00	8.00	8.00	7.80b	1.00^{NS} for judges 36.00** for treatments
Cow milk	9.00	9.00	9.00	9.00	9.00	9.00a	
	Flavour						
Coconut-natural milk blend	8.00	9.00	9.00	8.00	8.00	8.40a	0.4286^{NS} for judges 10.2857* for treatments
Cow milk	7.00	7.00	7.00	7.00	8.00	7.20b	
	Taste						
Coconut-natural milk blend	6.00	7.00	8.00	7.00	7.00	7.00b	0.1667^{NS} for judges 13.500* for treatments
Cow milk	9.00	9.00	8.00	9.00	9.00	8.80a	
	Overall acceptability						
Coconut-natural milk blend	9.00	9.00	8.00	8.00	9.00	8.60a	0.2308^{NS} for judges 9.8462** for treatments
Cow milk	7.00	6.00	7.00	8.00	7.00	7.00b	

Mean values sharing same letters are non-significant to each other.

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