COCONUT BASED BEVERAGES

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INTRODUCTION

Non-alcoholic beverages may either be carbonated or non-carbonated, naturally or artificially flavoured. In India, the most popular beverages are carbonated beverages or soft drinks and non-carbonated artificial fruit drinks. Carbonated beverages are generally prepared from a flavour base syrup, which is diluted, sweetened, acidified, coloured and treated with chemical preservatives and carbon dioxide. They are usually packaged in cans or returnable bottle. Juice drinks are similarly produced except that they are artificially flavoured and are not carbonated. They are usually packaged in stand-up aluminum pouches or tetra brik containers.

Products of the beverage industry have gained world wide acceptance and are extensively distributed. Indian beverage industry is not an exception. Beverages worth of millions are manufactured annually and marketed. They are low in food value and are prepared using imported material. Popularity of these beverages persists due to their thirst-quenching properties.

COCONUT WATER BEVERAGES

India produces large quantities of coconut water as a byproduct of desiccated coconut and copra industries. More than 250 million litres of coconut water, with a Biological Oxygen Demand (BOD) of 40 g/l is generated and disposed of annually in Kerala alone (Satyavathi, 1995) resulting in loss or waste of food values and causing environmental pollution. The development of food uses for coconut water would greatly help to solve these problems. The use of coconut water to produce vinegar and nata de coco (a gel formed during fermentation and consumed as a dessert) is now being practiced on a small scale. Studies have shown that coconut water can also be used to produce carbonated and non-carbonated beverages as refreshing and more nutritious than other similar products.

Composition of coconut water:

In the early stages of development of the coconut, coconut water is sweet and refreshing. As the nut matures, the sweetness diminishes, but retains much of its chemical components. It is rich in minerals, especially potassium, sterile in its natural form and very widely used in hospitals, for feeding infants and as a beverage by all.

Chemical composition of matured and tender coconut water of about seven month maturity is given in the Table 1 (Satyavati, 1995). After sugars, minerals are the most important in terms of quantity and quality of coconut water.

Table 1 : Chemical composition of matured and tender coconut water

Sl. No.	Component	Mature coconut water	Tender coconut water
1.	Total solids (per cent)	5.4	6.5
2.	Soluble sugars (per cent)	3.0	5.7
3.	Minerals (per cent)	0.5	0.6
4.	Protein (per cent)	0.1	0.01
5.	Fat (per cent)	0.1	0.07
6.	Acidity (mg, per cent)	60	120
7.	pH	5.2	4.5

The mineral composition of matured and tender coconut water is given in the Table 2 (Satyavati, 1995). Among the individual minerals, potassium accounts for more than 50 percent. It can also be seen that matured coconut water also contains considerable amount of nutrients especially minerals. The total reducing sugar and protein contents of coconut water increase as the coconut fruit matures. However, total reducing sugar content reaches a peak of 2.9 g/100 ml on the ninth month and then declines. The sugars include simple sugars such as glucose, fructose, and sucrose, and sugar alcohol, mainly sorbitol (glucitol). For less mature green nuts, the total concentration

Table 2 : Mineral composition of matured and tender coconut water

Sl. No.	Name of the minerals	Mature coconut water (in mg per cent)	Tender coconut water (in mg per cent)
1.	Potassium	247	290
2.	Sodium	48	42
3.	Calcium	40	44
4.	Magnesium	15	10
5.	Phosphorus	6.3	9.2
6.	Iron	79	106
7.	Copper	26	26

of sugars is equal to 5.15 g/100 ml. This explains why coconut water from young nuts is substantially sweeter than that from mature nuts. The utilization of coconut water as soft drink can make use of this nutritious produce as well as add to the gross return to the coconut farmers.

Production of non-carbonated and carbonated mature coconut water:

Del Rosario and Rubico (1979) formulated non-carbonated beverages from mature coconut water obtained from a local desiccated coconut plant. They conducted experiments on malic acid, ascorbic acid, citric

acid and combinations of acidulants and also on various sugar concentrations to increase total soluble solid content. The formulation which found most acceptable, is that with total solids adjusted to 10 to 12 per cent and pH adjusted to 4.2 using an acidulant and 0.1 to 0.15 per cent sodium citrate. The use of sodium citric acid mixture minimize the biting taste that has developed with the increasing amount of citric acid in the formulation.

Gonzalez et al. (1983) have developed the process for the production of non-carbonated and carbonated coconut water beverages utilizing water from mature nuts. The coconut water is filtered immediately through a clean cheese-cloth or mechanically through a suitable filter machine or passed through a basket centrifuge to separate coarse suspended particles. Immediately pH is adjusted with refined sugar. Sodium benzoate is added as preservative at levels permitted by the Bureau of Food and Drug. The prepared solution is pasteurized, passed through a three-way centrifuge to give clear non-oily solution and repasteurized further. Repasteurization may also be accomplished by passing through a High Temperature Short Time (HTST) heating unit in which case addition of preservative is not necessary and also pH and total soluble solids content need not be adjusted. This results in a natural drink.

For the preparation of the non-carbonated beverages, the hot repasteurized coconut water is packaged aseptically in clean containers such as beverage bottles, tin cans, laminated pouches or tetra briks and then sealed immediately. In non-aseptic conditions of packaging in bottles or tin/aluminum containers, processing further over steam at atmospheric pressure is necessary. The time of processing depends on the size of the can or bottle. For the preparation of the carbonated beverages, the repasteurized coconut water is cooled, carbonated and packaged aseptically in suitable sterile containers such as beverage bottle. In non-aseptic conditions of packaging, processing further at low heat in water bath is necessary.

A process has been developed at Regional Research Laboratory, Thiruvananthapuram for upgrading the matured coconut water to the level of tender coconut water and preserve it as a soft drink (Satyavati, 1995). The main operations involve collection, upgradation, pasteurization, filtration and bottling. The entire operations has to be carried out under strict hygienic conditions. The process essentially consists of up grading the flavour of matured coconut water to the level of tender coconut water by supplementation with additives including sugar and preserving by a judicious combination of heat-pasteurization and permitted chemicals.

Non-carbonated beverage from tender coconut water:

The tender coconut water is at its optimum level of acceptability and economical viability for commercial use when the nuts are of 6 month maturity. Later, the quality and the quantity of water decrease and hence its acceptability. So, it is ideal to preserve the tender coconut water at this stage of maturity to derive maximum advantages/benefits. Investigations were carried out at DFRL, Mysore to preserve the

tender coconut water in plastic pouches of 200 ml capacity and in aluminum beverage cans of 200 ml/350 ml capacity.

Since it is highly susceptible for heating, it is subjected to minimum heating by use of additives like nisin to achieve commercial sterility. This has helped in maintaining the natural pH of 4.9-5.2, instead of reducing it to below 4.5, which reduces the acceptability. Uniformity of the taste of the product could be ensured by sweetening agents, as there is a wide variation in the quality of the raw material depending upon the species, soil condition, watering and fertilizers (Srivatsa, 1995). Microbiological, chemical and organoleptic analysis have been done upon 3 month storage under ambient conditions. The product is found to be generally acceptable and it remained microbiologically sterile with no significant chemical changes.

Physiochemical, microbiological, organoleptic and storage properties of coconut water beverages:

Non-carbonated and carbonated coconut water beverages possess the characteristic flavour of coconut water, but this is slightly masked by the acid-sweetish taste imparted by different additives. Both products are highly acceptable and are preferred to other artificial fruit drinks. The carbonated and non-carbonated coconut water beverages keep well at refrigerated (5-10°C) and room temperature (28-30°C) storage. Storage at controlled temperature of 37°C does not alter much the acceptability of the products, except for a mild discolouration. The sharp flavour of freshly produced products mellows on storage and acceptability is greatly enhanced. At higher temperature (45-55°C), intense darkening of the product with scorched flavour can occur which is attributed mainly to caramelization and Maillard reaction. High temperature generally hastens these reactions which can adversely affect the quality of the beverages.

Coconut water concentrate:

One of the problems regarding the use of coconut water as feedstock for the manufacture of beverage and other products is the transportation, and prevention of spoilage during transport of the material from the source to the beverage factory. If the coconut water cannot be pasteurized and chilled immediately after collection due to lack of facilities or other constraints, then it must be transported at high cost, under refrigerated conditions to prevent spoilage. A possible solution to this problem is the concentration of coconut water into a form that is easily rehydrated, in order to reduce shipment weight, volume and cost, and to improve product stability. Potential end users of the concentrate include not only the food and beverage industry but also the fermentation industry, hospitals, research laboratories and the beverage consuming public, both in India and abroad.

Concentration of coconut water by Reverse Osmosis:

Coconut water is adversely affected by extended processing at high temperature, so a non-thermal concentration process has to be used. Given this constraint, one of the available techniques for producing coconut water concentrate is reverse osmosis. In the case of concentration of coconut water, the concentration is achieved by applying external pressure in order to overcome osmotic pressure and force the solvent (water)

through a semi-permeable membrane capable of retaining all or most of the dissolved substances, in effect reversing the normal osmotic process. Papa et al. (1986) obtained a concentration factor of five to six folds using 90 membranes at 4 MPa after 5 hours of reverse osmosis with continuous retentate recirculation. Maximal concentrations of sugar alcohol and protein for the retentate, namely 16.9 and 0.7 per cent respectively, were attained under these conditions.

A brief description of the process is as follows. Fresh coconut water from newly opened coconuts is collected under hygienic condition. Suspended solids and oil in the samples are removed by means of three-way centrifuge. The removal of the solids and the oil is necessary in order to minimize fouling or clogging of the membranes. The salts present in coconut water may be removed if desired, prior to concentration, to produce a very sweet product. This is achievable by passing the centrifuged coconut water through a mixed-bed ion-exchange resin. However, additional costs are entailed and problems dealing with regenerability of the resin need to be overcome. The concentrate can be frozen or preserved in cans and after dilution to the desired strength, it can be used as base for the production of carbonated and non-carbonated coconut beverages. The concentrated coconut water has also been used successfully in the brewery industry.

COCONUT FRESH KERNEL BASED BEVERAGES:

Coconut kernel have been used as food since ancient times. Men have obtained nourishment from this fruit by drinking the water of the tender nut and by using the pulp of the mature drupe. In the preparation of beverages, desserts and main dishes, the coconut pulp is used either grated or used in the form of coconut milk. In all coconut producing countries, where the people have a local supply of fresh coconuts, they are accustomed to the natural fresh flavour of the coconut pulp. Coconut milk and fresh grated coconut pulp are the basic forms for the utilization of the coconut as food, both at household and at industrial levels.

Fresh coconut kernel contains 151 IU of thiamine, 1 mg of ascorbic acid (vitamine C), traces of vitamin A and 0.2 mg of tocopherol per 100g. Coconut proteins are high in nutritive value and are fairly rich in lysine, methionine and tryptophane (Woodroof, 1970). The average proximate composition of ripe coconut kernel are furnished in Table 3.

Simulated dairy milk beverages based on Non-Fat Dry Milk (NFDM) and/or coconut milk:

Simulated dairy milk beverages are dairy milk substitutes formulated to contain nutrient approximating those of their dairy milk counterparts. The development of such types of products was motivated by the shortage of dairy milk in certain part of the world particularly in tropical countries where an adequate and stable supply of milk and milk products cannot be assured due to lack of a sizeable dairy industry. Dairy milk products in powdered form represent a large fraction of the food imports. These are often repacked for distribution or used in the production of evaporated filled milk, infant food formulations and milk based beverages.

Table 3 : Proximate composition of ripe coconut kernel

Proximate Composition	Authors			
	Menon & Pandalai (1958)	Woodroof (1970)	Grimwood (1975)	Sreenivasan (1967)
Moisture (%)	36.30	46.30	42-48	46.3
Fat (%)	41.60	37.29	36	37.3
Carbohydrate (%)	13.00	11.29	7-12	7.9
Protein (5)	5.60	4.00	4	4.1
Fibre (%)	2.50	3.39	2.0	3.4
Ash (%) (minerals)	1.00	1.03	1.0	1.0
Energy (kcal/100 g)	448.90	-	-	-

Substitution of milk fat with fats of other source reduce the cost of dairy products. Filled milk products are made by combining fats and oils other than milk fat with skim milk. Extensive trials have been undertaken in different parts of the world to study the physio-chemical properties of various dairy products made by partial substitution of milk components with those available from plant and animal sources. Low fat dairy spread is prepared by using vegetable oils to the extent of 10 to 30 per cent for partial replacement of butter fat.The production of filled milk is an important industry in non dairy countries. Canned evaporated filled milk and filled milk powder have become popular milk products which are used as beverages, as whitener for coffee and chocolate and as ingredients for snack foods and confectioneries.

Coconut milk and oil as fat sources of filled milk:

Bhandari et al (1975) prepared flavoured filled milk having 3.5 per cent fat and 8.5 per cent Solids Not-Fat (SNF) using coconut oil and dried skim milk powder. Filled milk of acceptable quality was made by Jenson and Nielsen (1982) using coconut oil. Creamed coconut, an hundred per cent coconut product can be put into use in the dairy industry successfully. Technology for production of coconut butter was developed. Fresh filled milk with coconut milk having pleasant coconut flavour and smooth aroma was prepared by Davide et al. (1987). Agarwall et al. (1991) prepared filled milk which is a product made from non-fat milk solids of liquid or powder origin in which vegetable fats or oil have been incorporated. Escueta et al. (1985) prepared a product named 'Tofu' by incorporating coconut milk and soyamilk. Thampan (1987) reported that coconut cream can be utilized as a fat source for the reconstitution of skimmed diary milk, infant milk powder and filled milk. Malaysian Agricultural Research Institute manufactured powdered coconut milk on commercial basis. The product can be stored for 18 months without refrigeration and antioxidant.

Filled milk products:

Various filled milk products can be developed by using NFDM as major portion along with coconut fat and/or protein. Simulated dairy milk products should be prepared under strict sanitary conditions and pasteurized to destroy harmful bacteria.

Beverage, evaporated and sweetened type:

Banzon (1978) explored the utilization of coconut milk as the main source of fat for the reconstitution of NFDM into three types of milk products viz., beverage type, evaporated type and sweetened condensed type. The milk was extracted single-strength from grated coconut meat, strained through cheese-cloth and pasteurized at 70°C for 2-3 minutes or 62-65°C for 30 minutes, cooled immediately and stored at sub-zero temperature for ready availability. The beverage type reconstituted milk is formulated to contain 3 per cent fat from coconut milk and 3.6 per cent protein contributed by coconut milk and NDFM. The evaporated type of reconstituted milk is more concentrated than the beverage type. It contains 6 per cent fat from the coconut milk and 7.3 per cent protein from the coconut milk and NFDM. This is approximately twice that contains in cow milk and the reconstituted filled milk (beverage type). The sweetened condensed milk requires sugar besides NFDM and coconut milk. The final product contains 8 per cent fat, 7.5 per cent protein and 40 per cent sugar. Sugar enhances the acceptability of the product, as well as improve its keeping quality. It is diluted with water to the desired sweetness prior to drinking or may be applied as bread spread. To prepare the products, NFDM is dissolved in warm water (40°C) and coconut milk is added. This is mixed thoroughly in a blender. For sweetened condensed milk, sugar is added to the blended material. A possible modification of the process is to augment the essential free fatty acid content of the produce using corn oil, which is thoroughly blended with the coconut milk before the products are prepared. Pasteurization of the products is advisable. Coconut milk and NDFM both have emulsifying properties and subsequently minimize coagulation of the proteins during the heating process. These products, which are for immediate consumption possess the wholesome flavour of coconut. They may be frozened or refrigerated if not consumed immediately.

Low-fat filled milk is prepared by dissolving the skim milk powder in water, then blending in coconut milk. The reconstituted milk is then heated to 55°C homogenized hot at 2000 psi, strained, repasteurized at 72°C, then immediately cooled to 3-4°C. The product is packaged in transparent plastic bags previously heated to 105°C for 15 minutes and sealed completely. The product has distinct coconut flavour and aroma and is rated only slightly less acceptable than commercial cow milk. Shelf life of the product is less than 24 hours at room temperature with coagulation after overnight storage. At refrigerated temperature (5-7°C), the product remains acceptable for 7 days.

Sweetened condensed filled milk is more stable than its unsweetened counterparts due to its higher sugar content. Its shelf life can be extended further by canning and then sterilizing over boiling water for about 30 minutes.

Coconut filled milk enriched with legume protein:

The use of coconut milk substitutes is of great nutritional significance in countries where coconuts and legumes grow in abundance. Mungbean, a traditional high protein dietary legume in India, is an ingredient in a number of low-cost, high protein rich foods, such as mungbean cookies and mungbean based patties. Mungbean is rich in lysine, an amino acid deficient in an average Indian diet.

The mungbean proteins isolate is prepared from starch free filtrate of the beans by adjusting the pH to 4.4. Cream layer formation was observed in both of unsterilized beverages and evaporated type products containing either NFDM or the mungbean proteins isolate. Heat sterilization for 15 minutes at 15 psi destabilize the emulsion further at a faster rate of cream layer formation and subsequent formation of coagulated materials in the product. The mungbean protein-treated beverages inhibits gelation during storage. Addition of emulsifiers and stabilizers and passing through the homogenizer of the pasteurized products prior to heat sterilization can minimize these problems.

Coconut skim milk beverages:

Coconut skim milk is the aqueous component of the coconut milk extract. It possesses the delicious sweetish flavour, the characteristic feature of young coconut. Coconut skim milk beverages are nutritious, particularly for pre-school and school-age children. It contains good quality protein as well as soluble carbohydrates including sugars that are originally present in the coconut meat. Its chemical composition depends upon the amount of liquid used for the extraction of the grated coconut meat. With a 1:1 ratio of meat-to-water, the skim milk typically contains 90 per cent moisture, 2.7 per cent protein and 0.6 per cent fat.

Ready-to-drink coconut skim milk:

Several studies were conducted that have resulted in the development of acceptable beverages based on coconut skim milk, either as instant flakes and powder or as liquid. Salon and Maniquiz (1969) developed a process of preparing coconut skim milk beverage The process can be well adopted in the villages using simple utensils, but observing strict precautionary measures in its preparation.

The coconut milk is hand extracted three times with water or coconut water. The extract is strained through a cheese cloth and left to stand in a percolator. The skim milk that separates at the bottom of the percolator is then collected and pasteurized at 60-67°C for 30 minutes in a water bath. After cooling, the product may be consumed immediately or stored at room temperature for later use in the day. The product is microbilogically wholesome and safe for drinking even after 5 hours at room temperature. It contains good amount of iron and niacin, but is deficient in fat, thiamine, riboflavin, calcium and phosphorus. The cream resulting from this process can be heated to produce the oil for cooking. A by-product is the latik or the protein-coagulated material which has a very rich and creamy flavour. The coconut residue can be used as feed for animals or toasted with sugar and used as snack food.

Beverages based on coconut protein concentrate:

Ready-to-drink coconut skim milk

protein can also be prepared by using the protein coagulated material obtained by heating the skim milk. The curdled coagulum is soft in texture and has the delicious flavour of young coconut meat. Gonzalez et al. (1983) formulated a simulated dairy milk product using the coagulum as the protein source and coconut cream and refined oil as fat source.

The mixture is heated, homogenized, packaged hot in tin cans, sealed and sterilized at 118°C for 9 minutes in a continuous agitating retort. Solidum and Genato (1987) likewise developed formulations for chocolate flavoured and unflavoured coconut skim milk beverage using the protein-coagulum.

Coconut skim milk powder:

Instant beverages in powder form are common household items and are popular among school-age children. These artificial drinks are composed of synthetic flavours, colourings and sweeteners and are almost devoid of food value. An attractive alternative to artificial powder drinks would be natural fruit drinks, which cannot be produced in powder form due to technological constraints. It is however possible to convert coconut skim milk into a powder which is easily dissolved to make a nutritious beverage.

Buccat et al. (1973) successfully produced a nutritious instant drink from coconut skim milk. The skim milk is mixed with sugar at 15 per cent level and initially concentrated in a flash evaporator. The concentrate contains 16 per cent moisture, 50 per cent sugar, 0.5 per cent protein and 9.51 per cent fat. It is creamy white in colour has a very viscous consistency and can be diluted with cold water to twice its volume to make a highly acceptable coconut drink. The final product is obtained by further drying the concentrate into flakes using a vacuum oven or a drum dryer. The flakes contain 4.45 per cent moisture and 25.2 per cent protein. The product gives a delicious refreshing drink upon reconstitution with ice-cold water. It is highly hygroscopic and should be packaged in moisture-vapour-proof containers.

Hagenmaier (1980) likewise developed a dry, non-dairy product from coconut skim milk which easily dissolves to make a sweetish, coconut-flavoured drink. Maltodextrin is as optional additive used to improve body and fluidity of the dehydrated product. Powder skim milk (without maltodextrin) has been tested in the preparation of bakery products to replace dairy milk ingredients. De Leon (1976) made cup cakes and nutribuns. However, it has limited prospects from the marketing point of view, partly because of the high cost of skim milk powder relative to wheat flour. As a beverage, the product has good potential. It is reported to have three flavour notes namely sweetish (primarily due to the presence of natural sugars), bitter-salty, presumably due to its high salt content, potassium in particular and fresh coconut flavour.

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