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A Preliminary Investigation on the Preparation of Vegetable Milk from Oilseeds and Pulses

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Introduction: Milk prepared from vegetable sources, chiefly the soya bean, has been in use in China, Japan, Korea and other Eastern countries from very early times. Children are fed on this milk substitute, and medical opinion in China is in favour of soya bean milk as a valuable substitute for natural milk in promoting growth and development. Bowdidge in his book on the "Soya bean" describes its effect on western palates as "nauseating to say the least". Different methods have been evolved in these countries for the preparation of soya bean milk, mainly consisting of washing the beans three times in water, soaking in water for 12 to 24 hours, heating to boiling point, grinding in a mortar and straining through a bag made of linen.

In the West there had been only sporadic attempts at investigation into the manufacture of milk substitutes, the probable reason being the availability of natural milk in abundance. During the World War I a synthetic vegetable milk was put on the market under the name "Lehman's Vegetable Milk". This was prepared out of beans like the soya and almond. The milk had a thick consistency, brown colour and a pleasant aroma. It had a composition of 7 per cent vegetable protein, 25 per cent fat, and 42 per cent sugar. One teaspoon of this vegetable milk with a pound of ordinary milk and a pound of water made a nourishing mixture, rich in fat and sugar though poor in protein. But this preparation had a farinaceous taste.

In recent times refined methods have been adopted for the preparation of milk substitutes. The details of processing are as follow. Ground beans are moistened, allowed to stand for 8 hours, treated with steam to deodarise and emulsified by triturating with water and pressing out the milk. The emulsion is again boiled for 5 minutes, treated with salt, glucose and soya bean oil, vanilla or almond extract added, agitated in a shaking apparatus and sterilised. Refined fat is also sometimes incorporated by emulsification at 60°C. In another process the seeds are germinated and ground with whey, water or skim milk, the pulp heated and fermented with enzymes to break down the proteins and carbohydrates, emulsified with vitamin-containing substances, homogenised

and dried by atomising in hot gases. The product is reported to be useful in rearing calves.

The practice of adding coconut 'milk' (prepared by kneading the scraped kernels with small quantities of water and pressing through cloth) to certain preparations is well known on the West Coast. The poorer classes sometimes use it with coffee as a substitute for milk. Cotton seed milk is known to be useful to nursing mothers for increasing milk secretion.

The purpose of the present studies was to see if milk can be prepared economically from oilseeds or pulses other than soyabeans and the quality of such preparations.

Materials and Methods: Trials were made in the laboratory on the preparation of vegetable milk from pulses and oilseeds. The pulses tried were horsegram, bengalgram and lablab, and among the oilseeds groundnut, cotton-seed and coconut were used. The pulses were soaked in water for over 8 hours after thorough cleaning and then ground into a paste, emulsified with water, filtered through muslin, the filtrate boiled a short while and again passed through muslin. A similar procedure was adopted for cotton-seed also, but groundnut and coconut kernels were crushed without previous soaking and the milk extracted by squeezing through cloth. The milks were then tested for their palatability by distributing them to different persons both as milk and added to coffee and tea.

Experiments were also conducted with a view to effect improvements in the quality of these milks and to get rid of their characteristic unpleasant flavours, by grinding the seeds to flour, adding water in sufficient quantities, boiling and pressing through muslin. The milk obtained was of the same quality as that obtained by the process described earlier. In the case of horsegram and bengalgram milk the flour was made into a paste with water and allowed to stand for several hours after which steam was passed for 15 minutes. More water was then added and the mixture triturated, filtered through muslin and boiled.

Discussion: The colour, consistency, flavour and other properties of these milks and their chemical composition are given in Tables I and II. It will be seen that cotton-seed milk approaches cow's milk in nutritive value. Groundnut and coconut milk have high fat content, but the latter is poor in proteins. The milk from pulses have a lower fat content than cow's milk, but could be made up

to approximate to the composition of cow's milk by the incorporation of suitable quantities of fat.

The products from pulses had the characteristic flavour of the respective grains which could not be masked even by the addition of flavouring agents like vanilla essence. The remarks made about soya bean milk may be said to apply in a greater degree to these milks. Tasters were unanimous in their verdict that these milk substitutes were repulsive either alone or added to tea and coffee. Coconut milk and cotton-seed milk were not objectionable when mixed with coffee, but taken alone they had a characteristic taste which could not be described as unpleasant. The high fat content of coconut milk and its proportionately low protein value might lower its usefulness as a milk substitute. The product from cotton-seed alone appears to deserve further investigation by nutrition experts in regard to its digestibility and toxicity, if any. The attempts to remove the odour from horsegram and bengalgram by modified techniques resulted in products which were worse than those of milk prepared by other processes.

Conclusions: Attempts were made to prepare vegetable milk from some pulses, groundnut, coconut and cotton seed. The preliminary studies show that milk prepared from vegetable sources is not likely to replace or supplement cow's milk in the dietary of the people of this country. Elaborate investigations will be required in the direction of deodourising the raw products and assessing the digestibility and growth-promoting properties of the protein from the different sources before such substitutes can be recommended for general use. Even soya bean milk which is said to approach natural milk in many respects has not attained universal popularity and opinions are divided regarding its digestibility.

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TABLE I

Notes on Quality of Different Milk Substitute

Name of milk	Colour	Odour	Taste	On boiling	Whole milk relished or not	Added to tea	Added to coffee
Cotton seed	Yellowish	Smell of soaked cotton seed not unpleasant	Acidic, not pleasant	Colour changes to yellow. Fine curds formed	Not relished	Raw milk seems all right. But on keeping precipitates are formed. When boiled milk is added a precipitate is formed.	Flavour and colour not bad. Taste—slightly bitter.
Coconut	Milk-White	Aromatic not unpleasant	Good and nutty	Curdles	Not bad	Raw milk flavour is not much affected. Fine precipitate appears. Boiled milk curdles.	Raw milk flavour is not unpleasant. Boiled milk is also all right. There is some after taste in either case.
Groundnut	Brownish white	Of crushed groundnuts	Acid and sweet	Coagulates	Not relished	Raw milk curdles. Taste not good.	Mixes well—Taste not good.
Black gram	Greenish white	Strongly of germinating seeds	Insipid	Thickens	Repulsive	Raw milk does not curdle, but taste is bad. Boiled milk curdles.	Raw milk or boiled milk mixes well. The taste is bad.
Lab lab	Brownish	Strongly of lab lab	Insipid	No change but odour increases	Repulsive	Raw milk does not curdle. Boiled milk curdles. Not relished by people.	Raw milk has a strong odour of lab lab, odour is imparted to coffee. Boiled milk curdles. Not relished.
Bengalgram	Creamy yellow	Fresh vegetable odour	Insipid	Thickens	Unpleasant	Raw milk as well as boiled milk also curdles.	Raw milk mixes well. Boiled milk curdles. Taste not good.
Horse gram	Brownish white	Characteristic odour of horse gram	Insipid slightly acid		Unpleasant	Mixes well but taste is not good.	Flavour is not much affected. Slight sour taste lingers on for a long time.

TABLE II

Showing the Composition of the Various Vegetable Milks

Name of milk	Specific gravity	pH at 29° C	Acidity as number of milligrams of KOH per 100 ml. milk	Moisture	Ash	Protein	Fat	Carbohydrates
Coconut ..	0·997	6·39	56	79·33	0·50	1·68	16·15	2·34
Cotton seed ..	1·020	6·86	257·6	88·04	0·85	4·42	4 98	1·71
Groundnut ..	1·018	6·78	89·6	72·22	0·64	6·79	14·40	5·95
Blackgram ..	0·945	6·65	22·4	97·47	0·18	1·02	0·61	0·72
Lab lab ..	1·028	6·21	..	90·50	0·75	5 32	0·54	2·89
Bengal gram ..	1·024	6·42	..	90·72	0·31	3·04	0·52	5·41
Cow's milk ..	1·030	6·90	67	87·30	0·80	3·20	3·50	5 20
Soya Bean milk ..	..	..	..	87·03	0·52	2·40	0·15	6·90