

Technologies for utilization of co-products of virgin coconut oil

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Today, coconut cultivation has reached an extent where the income obtained from the crops grown in between the coconut palms far exceeds than that of the harvested coconut. The bitter fact is that, in our country, cooking oil is the number one imported food item, keeping prices down since the market is flooded (full fledged) with other cheaper alternatives such as palm oil. Hence the need of the hour is to diversify the coconut into other value added products. A revival from the existing scenario has already been initiated as the farmers and entrepreneurs started focussing on other superior products like virgin coconut oil which is gaining popularity in recent times and has become a by-word in all parts of the world. The extolling articles, literatures, reports, news and advertisements on the functional properties as well as the premium market price of VCO made a positive impact on the adoption of the VCO technology among the farmers and entrepreneurs.

The so called mother of all oils, Virgin coconut oil (VCO) is the oil obtained from the fresh and mature coconut kernel through mechanical and natural means, with or without the use of heat. It is called 'virgin' because the oil obtained is pure, raw and pristine. During the process chain of VCO, a number of by and co products are obtained such as husk, shell, testa, nut water, coconut milk residue and VCO cake. VCO processing from 500 nuts give rise to about 200kg husk, 67kg shell, 50l nut water, 3.3kg testa, 25kg milk residue and 5kg VCO cake. Husk has immense uses in coir industries, preparation of potting mixture etc. Shell charcoal, activated carbon, and shell flour are the commercial products obtained from the shell. Mature coconut water is commercially utilized for the preparation of vinegar, production of Nata de coco and soft drink or squash. Testa is enriched with phenolic compounds (0.9 to 2.3g Gallic Acid Equivalent/ 100g dry weight), has good antioxidant activity and is used as an ingredient in high fibre digestive biscuits. Milk residue and VCO cake are the two co-products, presently underutilized or thrown as a waste.

The per cent recovery of coconut milk residue and VCO cake ranged from 38.5 to 55.6% and 6.3 to 8.8%

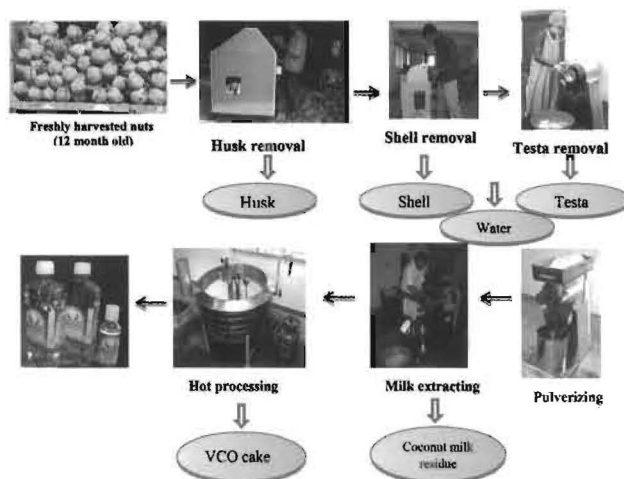
respectively. Utilizing these co-products would serve as a practical solution for the residue management and provide an additional source of income for the stakeholders. This article is focussed on exploring the diversified value added products from the milk residue and the VCO cake. The following process flow chart explains the extraction of milk residue and VCO cake during VCO production.

Utilization of coconut milk residue (CMR)

Coconut milk residue at 2.9% moisture level contains 46.5% dietary fibre, 5.3% protein, and 49.2% crude fat. It has 4 times more fibre than oat bran, 2 times than wheat bran, which in fact, is calorie free. It is loaded with nutrients and it is free from gluten and phytic acid. It is also a source of polyphenolics (23.5mg Gallic Acid Equivalent/ 100g) and has antioxidant activity (108.5mg Trolox Equivalent/ 100g). As a source of dietary fibre, it can improve the bowel movement, provide protection against coronary heart diseases, colon cancer and diabetes. Some of the value added products developed from the milk residue are described below,

Low fat desiccated coconut flour

Milk residue can be dried to 3-5% moisture content



Process flow chart of VCO production along with the co-products generated



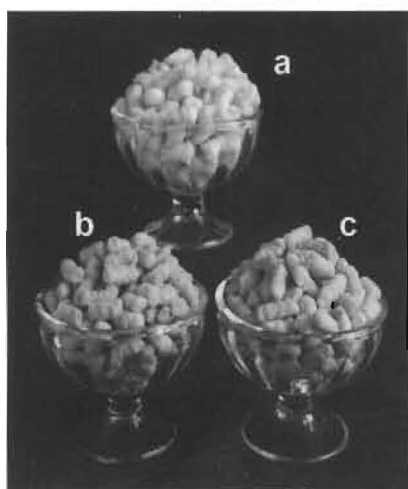
Low fat desiccated coconut flour packed in LDPE pouches

and sold as low fat desiccated coconut, which can be used for the preparation of bakery and of low calorie foods. It can be used as fillers, bulking agents and substitute for wheat flour, rice flour and potato flour at certain levels and incorporated into

baked and extruded food products. Five percent coconut milk residue flour can replace proportionate amounts of wheat flour and non-fat dry milk powder used in school nutrition programmes without affecting the baking qualities and food value.

CMR based extruded snacks

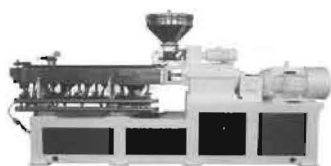
Extrusion cooking is used worldwide for the production of expanded snack foods, ready-to-eat



Extruded snacks:

- a. CMR + Broken rice
- b. CMR+ Maize
- c. CMR+ Pearl millet

breakfast cereals, baby foods, pasta and pet foods. Extrusion techniques are of two types. One is hot extrusion another is cold extrusion. The hot extrusion cooking process is high temperature short time process in



Co-rotating twin-screw extruder (10.0 HP motor, 400 V, 50 cycles, L-TSE mode) Sic Technologies Private Ltd., Kolkata, India)

which moist, soft grains are fed into the extruder where the desired temperature and pressure are obtained over the required period of time. Heat for cooking is achieved through shear and friction in the extruder.

Coconut milk residue flour could be well utilized for the preparation of extruded snacks just like the kurdure available in the market. A composite formulation of coconut milk residue based cereal snacks was standardized at the ICAR- CPCRI and it was found that 20% milk residue was optimum for the preparation of extruded snacks with three types of cereals such as broken rice (20: 80), maize (20: 80) and pearl millet (20: 80) in twin screw extruder which had good acceptability with a maximum shelf life of 6 months when packed in laminated pouches.

CMR based pasta

Pasta is the main product prepared through cold extrusion. Pasta products are becoming popular in today's lifestyle because they are healthy, tasty and convenient for transportation and preparation.

Approximately 12.3 million tonnes of pasta is produced worldwide with an estimate of 100,000 tonnes production of India. Among cereals, only wheat (in the form of semolina or suji) is used for pasta preparation because of the presence



Cooked pasta prepared with different levels of CMR

of the protein gluten in it. An attempt was made by the ICAR- CPCRI to enrich the pasta with dietary fibre by incorporating coconut milk residue at different concentrations. Among the different levels of coconut milk residue evaluated, 10% CMR was the optimum in terms of the cooking qualities, textural properties and sensory attributes. By supplementing 10% CMR in pasta, maximum Daily Recommended Allowance (DRA) of 6.5g fibre can be met.



Pasta extruder

CMR based Bread

Refined wheat flour (maida) lacks dietary fibre; the partial substitution of refined wheat flour with coconut milk residue can fortify the bread with dietary fibre. The ingredients required for two loaves include, 500g refined wheat flour, 5g yeast, 10g sucrose, 10g shortening (vegetable fat), 8g salt and 300ml water. Maida was partially substituted CMR up to 20%. Then the dough was kept for fermentation at 30°C for a total of 240 min. The baking temperature was 230°C for 30 min.



CMR based sweets/ laddoo

The optimized recipe for the preparation of coconut milk residue based laddoo includes, 25% milk residue, 32% sucrose, 12% desiccated coconut, and 7% refined wheat flour, 12% shortening (vegetable fat), 9% water and 3% cashew nuts. Wheat flour was roasted with the shortening in a pan, followed by addition of desiccated coconut powder and coconut milk residue which was heated to 150°C for 15min and when it reaches down to 90°C, sugar (preferably powdered sugar), dried nuts and water were added. The mixture was continued to heat till it attains the consistency for making into the shape of laddoo. The size of the laddoo was standardized to 25g.

Coconut milk residue was used along with partially fermented neera to prepare laddoo. Partially fermented neera (5.5 pH) was boiled in a double jacketed vessel. When it reached at 75°Brix, dried coconut milk residue was added at 1.5% of the initial volume of neera and concentrated till it reaches the desired consistency.



CMR based porridge

The standardized ingredients for coconut milk residue based porridge includes, 25% residue, 25% sucrose, 20% skim milk powder, 10% pineapple powder, 8% green gram powder, 5% sweet potato powder, 5% carrot powder and 2% gooseberry powder.



Utilization of virgin coconut oil cake

The brown coloured VCO cake locally known as Kalkam is rich in protein (20.12 %), fat (35.57 %), crude fibre (3.8 %) and dietary fibre (12.75 %). It has 4 times more antioxidant potential (446.88mg Trolox Equivalent) and 6.5 times phenolic activity (158.07mg Gallic Acid Equivalent) than coconut milk residue. It also contains 22.08% total soluble sugars and 1.57% reducing sugars. VCO cake can be utilized for protein enrichment especially in cakes and snacks. The following products were standardized from dried VCO cake at ICAR- CPCRI.

VCO cake based Extruded snacks

VCO cake concentration was optimized in maize and broken rice based extruded snacks. VCO cake flour was mixed with maize grits and broken rice (sieved using 30 mesh size) at a fixed ratio of 2: 1 (maize to broken rice) on co-rotating twin-screw extruder (10.0 HP motor, L-TSE model, Basic Technologies Private Ltd., Kolkata, India) with die opening of 3.0 mm. Optimized condition obtained was 29 % VCO cake along with 2:1 ratio of maize and broken rice with 14 % feed moisture at 300 rpm which had good physical, textural and sensory properties. The resulted snack was enriched with 11.14% protein, 5.07% fat, 2.3% ash and 74.19% carbohydrate. The product was found to be shelf stable for more than 6 months when packed in laminated pouches. Because of the natural sweetness of VCO cake, the additional step of flavouring could be avoided.

VCO cake based muffins

Muffin is a sweet baked product appreciated among



the consumers of all age groups, especially children due to its good taste and soft texture. The ingredients of muffins such as refined wheat flour, sugar, fat, and egg play an important role in the structure, appearance, and eating quality of the final product.

Muffin batter formulations were made by progressively replacing the refined wheat flour with VCO cake. The optimized formulation consisted of refined wheat flour (26g/100g) which was replaced with 40% VCO cake flour, sugar (26g/100g), egg (21g/100g),

full fat milk (13g/100g), shortening (12g/100g), sodium bicarbonate (1.1g/100 g) and salt (0.1g/100g). Effect of the cake on physical, textural, microbial and sensory attributes of muffin was evaluated and found superior in all the parameters. Moreover, the texture of the muffin became softer with the addition of VCO cake. 40g VCO cake/100g flour blend based muffin was enriched with protein (8.49%), fat (18.46%), crude fibre (1.14%) and minerals (1.15%).

In conclusion, Coconut milk residue and VCO cake are the two underutilized co-products obtained during the production of virgin coconut oil. They represent approximately 35-50% and 5-10% of the weight of the fresh grating respectively. Both of them contain appreciable amount of oil which could be recovered through commercial oil expeller (41.24 % and 25.72% in milk residue and VCO cake flour respectively) along with the friction material like testa or copra at 10% level. The dietary fibre rich milk residue and protein rich VCO cake have a huge scope in value addition. Hence, value addition of these co-products into processed products including extruded snacks, pasta, sweets and baked products such as muffins is completely a new intervention which could provide health benefits through enhanced nutrients and minerals and provides immunity because of the presence of phenolics and antioxidants. Even small and marginal entrepreneurs and Self Help Groups could be benefited through involvement in processing of this value added products. ■