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Effect of coconut kernel residues on serum lipid concentrations of rats

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Abstract

The coconut kernel residues are underutilized by products in coconut milk and coconut oil industries. The residue from coconut milk (MR) and virgin coconut milk (VOR) can be used effectively for human consumption. Therefore, studying its nutritional effects on serum lipid profile is very important to promote for human consumption.The objective of this study was to determine the nutritional effect of VOR and MR incorporated diets on serum lipid profile of rats. The experimental diet was prepared by incorporating 10 % or 20 % VOR or 10 % or 20% MR. The control diet did not include VOR or MR. The blood samples were drawn at base level and thereafter at 30 days intervals. The initial concentrations were compared with the concentrations at each days using unpaired t test for testing significant differences (p=0.05).The increase of serum TC concentration of rats fed with 10 and 20 % MR and 20 % VOR was19 %, 17 % and 16 % respectively while the increase shown by control group and 10 % VOR group was 20 % and 22 % respectively at 120 days although there is no significant change. Significant increase in serum HDL-C was shown by rats fed with 20 % VOR in 30 days. Triacylglyceride, TAG, concentrations of rats fed with 20 % VOR significantly decreased significantly by 22 % in 120 days while the control group increased significantly by 31 %. However, 10 % VOR and 20 % MR fed group showed insignificant decrease in serum TAG. This study reveals that VOR and MR can potentially decrease the serum level of TC and TAGs in human.

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1. Introduction

Dietary fibre has been defined as the remnants of plant cells, polysaccharides, lignin and associated substances resistant to hydrolysis by human alimentary enzymes. Considerable amounts of work have been carried out to determine the nutritional characteristics of various by- products of plant based food using both human and animals and inconsistent results were observed[1,2,3]. Coconut (*Cocos nucifera*) is one of the major fruit crops used for preparation of coconut oil and coconut milk which are used in food, pharmaceutical and cosmetics industries and domestic food preparations. The preparation of coconut oil and milk leave behind coconut meal which is rich in food grade fibre and used as an effective substitute for food grade fibre[4,5]. Approximately 30 - 40 % of coconut meal is formed during the virgin coconut oil production process and may be considered for production of food grade fibre[5]. The aim of this study is to investigate effects of residue by-products obtained from expelling of oil or milk from coconut on serum lipid profile. Wistar rats were fed with coconut milk residue (MR) or virgin coconut oil residue (VOR) incorporated diets for a period of 120 days and the effect on serum lipid concentrations was determined. The results of this study are likely to encourage the wide utilization of coconut residue as a functional food.

2. Material and Methods

2.1 Coconut milk residue (MR) and virgin coconut oil residue (VOR)

Coconut milk residue (MR) and virgin coconut oil residue (VOR) were prepared by using the methods reported previously [5].

2.2 Experimental feed

The basal and the control rats feed was broiler starter feed procured from local market. The 10% and 20% VOR feeds were prepared by addition of 10 % or 20 % VOR to control feed. The 10 % and 20% MR feeds were prepared by adding 10 % or 20% MR to the control feed.

2.3 Analysis of serum lipids concentrations

Thirty five Wistar rats (8 weeks old male; 200 g) were purchased from the Medical Research Institute of Sri Lanka. The animals were divided into five groups of 7 animals each and were kept in an air conditioned (25 ± 1^{o} C) and light controlled room. The rats were fed with basal feed for a period of one week for familiarization of the feed. The basal blood samples (0.5 ml -1ml) were drawn from rats after a14 hour fasting period from coccygeal vein of the Wistar rats as per the protocol of Animal house, Medical Research Institute of Sri Lanka. Blood samples were collected at monthly intervals after the commencement of the experimental feed, transferred to 1.5ml eppendorf tubes and centrifuged for 10 minutes at 5800 g to separate serum. The samples were analysed for TC, HDL-C and TAG using Randox analysis kit (UK).

2.4 Statistical analysis

Experiment carried out in randomized block design. The results were expressed as mean values with standard deviation (n=7) and significant difference ($p<0.05$) in rows were analysed by one way ANOVA using SAS (1998). Initial means values were compared with those of different time intervals by student t test at $p<0.05$ level. Mean values with different letters in rows are significantly different compared to the mean value of basal level.

3. Results and discussion

As shown in Table 1 serum total cholesterol concentration of rats in general increased during 120 days with the exception of a significant decline at 60 days in rats fed with control and MR incorporated feeds.

Table 1. Serum TC levels of rats fed with VOR and MR incorporated feed

Treatment	Total cholesterol level (mg/dl)				
	Basal level	30 days	60 days	90 days	120 days
Control	74.58±7.46a	81.53±11.26a	67.91±9.92 c	88.10± 9.36b	89.89±5.61b
10%VOR	71.60±9.46a	82.29±5.07a	89.13±8.64b	79.37±4.30b,a	87.97±10.48b
20% VOR	71.98±3.77a	76.86±4.12a	86.07±9.80b	85.51±3.94b	85.71±4.26b
10% MR	74.16±7.35a	69.03±5.20a	61.90±7.19c	89.30±11.41b	86.84±7.15b
20% MR	75.82±6.84a	75.10±5.37a	57.64±5.34b	88.29±7.75b	87.70±9.41b

Over the experimental period of 120 days, the increase in serum TC concentration varied from 16 -17 % in the MR feed fed groups, 19 % in the 20 % VOR, 23 % in the 10 % VOR feed fed groups and 20 % in the control group compared to the commencement. Therefore rats fed with 20 % VOR and 10 % and 20 % of MR incorporated feeds showed lesser increase in serum cholesterol after 120 days compared to basal values.

Significant change in HDL-C was observed only in the rats fed with 20 % VOR incorporated feed in 30 days (Table 2). Rats fed on control and VOR incorporated feed showed significant increase in HDL-C at 90 and 120 days compared to the basal concentration. However, serum HDL-C of the rats fed with MR incorporated feed remained near basal levels at the completion of the experiment.

Table 2. Serum HDL-C cholesterol levels of rats fed with MR and VOR

Treatment	HDL – C concentration (mg/dl)				
	Basal level	30 days	60 days	90 days	120 days
Control	54.32±4.64a	59.91±5.04a,b	46.78±3.57c	63.87±6.47b	66.78±5.28b
10%VOR	52.52±4.55a,c	65.88±4.14a,b	46.42±1.98c	65.04±8.65b	69.38±5.86b
20%VOR	54.79±3.97a,c	66.71±2.28b	52.78±6.83a	72.63±4.39b	63.37±9.72b,c
10% MR	65.92±7.15a	54.26±7.09b	48.21±4.99c	69.04±7.77a	60.63±6.34a
20% MR	64.56±5.70a	64.53±5.34a	49.48±4.66b	70.17±8.44a	61.54±4.85a

The rats fed with control feed and 10 % MR containing feed showed significant increase in serum TAG with time compared to the commencement (Table 3) while rats consuming 10 % VOR or 20 % MR containing feed did not show a significant change at 120 days. The rats fed with 20 % VOR incorporated feed fed groups showed 22 % significant decline of serum TAG concentration at 120 days. According to the results incorporating both 10 % MR and 10 % VOR in the feeds are not enough to show the effect of fibre.

Table 3. Serum TAG concentrations of rats fed with VOR and MR added feed

Treatment	TAG concentration (mg/dl)				
	Basal level	30 days	60 days	90 days	120 days
Control	159.2±15.2a	204.1±36.4a	229.2±62.1a	204.0±36.0a	232.6±42.4b
10%VOR	164.3±27.6a	167.2±22.9a	276.2±36.5b	186.8±29.6a	190.9±32.6a
20%VOR	201.6±38.7a	107.4±26.2c	244.3±29.1a	168.6±25.1b	157.8±50.0b
10% MR	127.7±34.8a	97.1±23.7a	156.1±15.2a	145.7±31.7a	174.9±70.8a
20% MR	155.3±30.3a	121.9±37.7a	154.9±19.6a	123.6±25.4a	134.1±15.3a

A previous study has shown significantly lower TC concentration of rats fed with a diet incorporated with 22 % carrot residue in 30 days compared to a control group[3]. Further this study observed non- significant decline of Serum HDL-C concentrations. In contrast, serum TC of rats of all groups did not change significantly in 30 days in our study, however, 20 % VOR incorporated feed fed group showed 22 % increase of HDL-C compared to the basal concentrations. Therefore VOR gives a different result compared to carrot residue. It was observed that lowering of

serum TAG of rats in 30 days[3]. Similarly rats in the present study showed similar results when fed with 20 % MR and VOR incorporated feed. Therefore higher proportion of raw fibre in the diet cause lower serum TAG concentration in rats. According to another study when the mice were orally fed with okara fibre solution in 0.3g / kg body weight decreasing effect of serum TC and non-significant decline of serum HDL-C were observed[2]. Further they observed reduction in particle size gave declining effect in serum TC and TAG and improved serum HDL-C. Flax seed fibre incorporated drink lowered total TC in rats in 15 % while when the fibre was incorporated to bread it lowered in 7 % only[1]. Therefore effects of fibre on lipid profile depends on source of fibre, levels of incorporation, time duration, physical properties and method of feeding.

4. Conclusions

Coconut virgin oil residue (VOR) and coconut milk residue (MR) incorporated feeds are favourable for lowering increase of serum TC and lowering serum TAG concentrations and to increase serum HDL-C at a higher level of incorporation. Therefore both MR and VOR show good potential for use as a source of dietary fibre in functional food preparation.

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