Consumption of coconut Oil- Clinical Studies, Sri Lanka

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Senadheera quoting a work by Nicholas and Paranavitharana states that in Sri Lanka, coconut groves are mentioned in early inscriptions as well as in literary works dating to about the 2nd century AD and that its nuts were eaten when tender . Robert Knox in the 17th Century wrote– "Coconut provided toddy, wine, vinegar, oil, milk and honey … all eatables, Besides it affords other necessaries as mats, brooms, bottles, dishes and ropes" –.Knox's statement was probably the first which spelled out the many uses of the coconut tree so vividly.

Research on Clinical studies relating to coconut & coconut oil in Sri Lanka have occurred in two phases. The 1st between 1960 and 2001 concentrating mainly on coconut fats and plasma lipids in relation to Ischaemic Heart Disease (IHD. Coconut has been one of the major dietary components in the Sri Lankan diet for hundreds if not thousands of years. Based on Central Bank reports, in the last few decades, coconut consumption has been declining from around 130 nuts/ person/year to now less than 100 nuts/person/year. A 2004 study on coconut oil (CO) by Peiris, Fernando and Samarajeeva have shown that while 91.2% of the sample population in three districts, Colombo, Kurunegala and Nuwara Eliya used CO, in 75% of them the quantity of CO consumed has declined over the last 5 years. The proportion using CO declined with increasing affluence, while 99% of those earning < Rs. 3500/- a month used CO, only 70% of those having an income of > Rs. 5000/- were CO users. They also found that the reasons why high income earners in our country turned to the use of other vegetable oils were the poor quality of CO in the market or its adulteration with cheaper imported vegetable oils particularly palm oil and the "misconception" about the harmful effects of CO. In an unpublished study it was found that rural sector has significantly higher use of coconuts / person/ year than the estate and urban sectors (93.5, 78.8 and 71.6 nuts respectively). A 1961 study had shown that among medical students living in the hostel, males consumed more fat than females and the fat contributed 30 & 24% of the calories respectively, about half coming from coconut. Coconut is consumed in several forms –as coconut oil used for deep frying and sautéing and a major portion of the oil purchased may not actually be consumed being thrown away after repeated use. Coconut is also used as coconut milk in curries and in porridge and in milk rice and as scraped coconut in sambols and salads. There is no reliable information on the relative ratio of coconuts that are used in the different forms. Coconut oil contains >95% fat, while scraped coconut has about 36% and coconut milk is variable but averages around 24%.

Coconut oil and Ischaemic Heart Disease

It was reported in 2010 that the age and sex standardized prevalence of IHD in Sri Lanka at 9.3% with the main risk factors being hypertension, one or more lipid abnormality, smoking, physical inactivity, obesity, diabetes and a family history of diabetes. This is a recent phenomenon, Kaunitz mentions quoting from The Demographic Yearbook of the United Nations (1978) that Sri Lanka reported the lowest death rate from ischemic heart disease (IHD) and that Sri Lanka is the only one of the countries giving reliable data where coconut oil (containing over 50% medium chain fatty acids) is the main dietary fat. Coconut consumption has in fact decreased over the last 50 years and is higher among the rural than among the urban population.

	No. of subjects	Total cholesterol	Triglycerides
Urban area	63	5.22 ± 0.10a	1.38 ± 0.09
Suburban area	37	4.76 ± 0.15	1.49 ± 0.13a
Rural area 1	38	4.78± 0.10	1.17 ± 0.07
Rural area 2	29	4.73± 0.13	1.21 ± 0.11

Table 1. Concentration of total cholesterol and triglycerides in the serum from Atukorale & Jayawardena 1991.

	Nut consump./person/week	CO – ml/person/week
Cases	1.97 ± 0.81	88.44 ± 61.6
Controls	2.11 ± 1.01	81.4 ± 51.52
P value	P = 0.66 NS	P = 0.175 NS

Table 2: Adapted from Results of Coconut and coconut oil consumption among cases and controls – Athauda et al 2015

Group	Blood glucose mg/dl	Tot. Chol. mg/dl	HDL mg/dl	TG mg/dl
1.CNO	-13.87	9.05	1.47	-31.1
2.VCO	- 7.22	-8.08	8.32	-20.75
3.GC+CNO	-41.88b	6.11	0.82	-30.5
4.GC+VCO	-41.85b	1.65	-10.82	-49.8

Table 3. Changes in mean blood glucose, total cholesterol, HDL cholesterol and triglyceride levels after 36 weeks. bp< 0.05 (Modified from presentation by Samaranayake H.A.E., Chakrawarthy S., Karunakaran R, Wickremasinghe A.R. 2015)

In one of the earliest studies, Athukorale and Jayawardena looked at lipid patterns in 167 healthy subjects in the age group of 28 to 50 living in an urban area, a suburban area and two rural areas to determine a possible relationship between their serum lipid patterns and food habits. They found that those in the coconut growing rural area consumed significantly less coconut oil than urban dwellers although the contribution of coconut to the fat derived energy was highest. Most of the fat energy was from coconut milk and scraped coconut. However, the mean total cholesterol shown in Table 1 was significantly higher for those in urban area subjects than that of other areas while subjects living in suburban area had a higher mean triglyceride level which was attributed to higher alcohol consumption among these subjects. They found that the risk of coronary heart disease as assessed by the body mass index, ratios of total cholesterol to HDL-cholesterol, and LDL-cholesterol to HDL-cholesterol, was significantly lower in subjects in rural areas, who were agricultural workers with a high degree of physical activity, subsisting on a diet consisting mainly of plant food, despite a higher consumption of coconut, a saturated fat. The glactomannans and fibre in kernel products used predominantly in rural area two may have contributed to the lower TC levels.

The Coconut Research Institute – Faculty of Medicine, University of Kelaniya research group has done a retrospective study looking at coconut and coconut oil consumption in the Sri Lankan population in relation to all cardiovascular deaths over the period 1961to 2006. Average consumption of coconut including copra was 66.19 kg/capita/year (about 110 nuts/year), average energy supply from coconut products was 271.47 kcal capita/day and average fat supply from coconut products was 24.46 g/capita/ day. The relationship between CVD Death Rates (per 100,000 populations) and coconut oil consumption in Sri Lanka 1961-2006 are shown in Fig 1. They concluded that consumption of coconut and its products have remained unchanged from 1961 to 2006 while CVD death rates and the proportionate mortality rate due to CVDs have increased from 1961 to 2006. CVD death rates were negatively correlated with coconut or coconut oil consumption and there were no lags seen. CVD death rates were correlated with per capita GDP. Confirming what Kaunitz had suggested way back in 1986.

A hospital based case control study was conducted at the Colombo North Teaching Hospital, Ragama Sri Lanka comprising 176 cases and 148 controls. Previously healthy patients admitted with a first incident Acute Coronary Syndrome (ACS) or a Cerebrovascular Event (stroke) were recruited as cases and patients with no previous history of CVD or diabetes mellitus were recruited from surgical wards as controls. There were 136 ACS and 40 stroke patients as cases. An interviewer administered questionnaire was used to estimate the average consumption of coconut (nuts and oil) and to obtain information on risk factors of CVD. The results are shown in table 2. The study concluded that there was no evidence of an association between coconut consumption and incidence of cardiovascular disease or stroke. Use of coconut oil had a protective effect on the incidence of cardiovascular disease.

Interventional studies

In a short term interventional study, effect of totally replacing CF in the diet with soyabean fat and corn fat was shown. In one study they investigated the influence on plasma lipids of isoenergetic diets containing 30 % energy as fat, with a PUFA:SFA ratio of 4´00 or 0´25, consumed for 8 weeks by twenty-five young normolipidaemic males. During the soya bean-fat eating period the TC level fell significantly compared with baseline values and during the CF-eating phase TC level increased significantly compared with the soyabean-eating period .P < 0.01. Concomitant with the lowering of TC and LDL-C, there was also a reduction in HDL-C levels. On the soyabean-fat diet, HDLC decreased by

15 % (range 6±35 %). A long term interventional study in 60 volunteers with no exclusion criteria was reported by the same group in 2001,where the specific objectives were to examine the short-term and long-term effects on the serum lipoprotein profile when: 1. CF content in the diet is reduced; 2. CF in the diet is reduced and replaced with a combination of soyabean fat (PUFA) and sesame oil (oil of Sesamun indicum seed, containing 40 g MUFA/100 g fat). At the end of phase 1, there was a 7′7 % reduction in cholesterol (95 % CI 23′6, 212′2) and 10′8 % reduction in LDL (95 % CI 24′9, 216′5) and no significant change in HDL and triacylglycerol. At the end of phase 2, the reduction in cholesterol in both groups was only about 4 % (95 % CI 212, 3′2) partly due the concomitant rise in HDL. The reduction in LDL at 52 weeks was significantly higher in group B (group A mean reduction 11 %, 95 % CI 220′1, 22′0 and group B mean reduction 16′2 % 95 % CI 223′5, 28′9). In phase 2, triacylglycerol levels showed a mean reduction of 6′5 % in group 2A and a mean increase of 8′2 % in group 2B. The authors concluded that, a reduction of saturated fat in the diet is associated with a lipoprotein profile that would be expected to reduce cardiovascular risk. Of the 60 subjects 38 were hyperlipidaemics and this may have influenced the outcome. It is important that a long term dietary interventional study be done involving healthy normolipidaemic subjects.

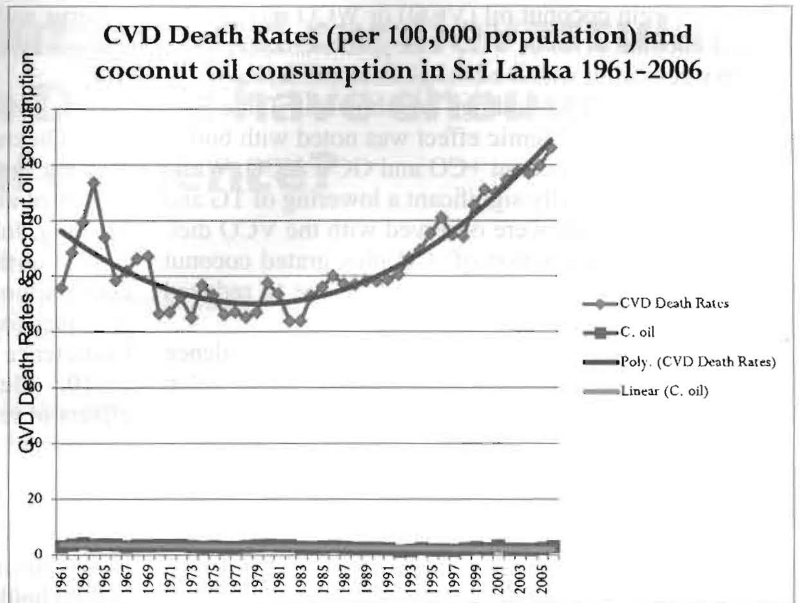

Fig. 1 From presentation by Atauda et al 2014.

A 2013 study, where 60 healthy volunteers were fed a normal diet supplemented with 200 ml of Coconut milk porridge (CMP) for 8 weeks followed by a washout period of 2 weeks and then 200 ml of Soya milk porridge (SMP) for 8 weeks . Serum lipids were measured at the beginning and end of each phase (4 assays in all). The difference in the mean values between the post and the base HDL levels with the CMP supplementation was 9.6 mg/dL (standard error of the difference between the means (SEM) 1.6 mg/dL), and the difference was statistically significant ($P < 0.01$). The difference in the mean values between the post and the base LDL levels with the CMP supplementation was –14.9 mg/dL (standard error of the difference between the means (SEM) 6.2 mg/dL), and the difference was statistically significant ($P = 0.02$). The difference in the mean values between the post and the base HDL levels with the SMP supplementation was 1.8 mg/dL (standard error of the difference between the means (SEM) 1.3 mg/dL), and the difference was not statistically significant. The difference in the mean values between the post and the base LDL levels with the SMP supplementation was –11.8 mg/dL (standard error of the difference between the means (SEM) 6.7 mg/dL) and indicated a marginally significant difference ($P = 0.09$). Therefore, SMP supplementation seemed to be effective in decreasing the LDL levels but has no significant effect on the HDL levels. The study concluded that there seems to be experimental evidence to support the view that the lipid effects of coconut milk/kernel would be different from those of the pure oil due to the salutary effects of the fiber and protein. Hence coconut milk and coconut kernel would reduce LDL cholesterol, whereas the oil itself could be neutral, leading to a net reduction in LDL. These changes were observed despite the CMP meal resulting in an increase of the estimated saturated fat content in the diet from 52g to 75g accounting for 20% of total calories much higher than the 10% recommended from saturated fat.

The fact that grated coconut in the Sri Lankan diet is less likely to elevate serum lipids is also borne out by two animal studies that have been reported in the last few years. In one, a diet containing 2.5% or 7.5% soluble fibre or 10% insoluble fibre derived from the coconut kernel residue obtained after virgin coconut oil is processed was fed to male Wistar rats along with a high saturated fat diet for 90 days. The soluble fibre at 7.5% and insoluble fibre at 5 & 10% were cable of reducing Total cholesterol and Triglycerides. Galactomannans obtained from defatted sugar removed coconut kernel has been reported to significantly lower total cholesterol, LDL cholesterol and to elevate HDL cholesterol.

Samaranayake and colleagues fed white coconut oil

(WCO), virgin coconut oil (VCO) or WCO mixed with grated coconut (1:1) or VCO and grated coconut (1:1) for 36 weeks after which blood glucose and serum lipids were measured. The findings are shown in Table 3. A significant hypoglycaemic effect was noted with both a mixture of grated coconut +CO and GC + VCO. While though not statistically significant a lowering of TG and a rise in HDL levels were observed with the VCO diet. This hypoglycemic action of CO plus grated coconut or VCO plus grated coconut could be due to reduced insulin resistance.

In conclusion, it can be said that while the prevalence of IHD, type 2 DM and MS are increasing in Sri Lanka, and more so in the urban areas and among the more upper social classes; studies carried out have suggested that coconut consumption particularly coconut oil is decreasing overall and possibly even more among this very same group. Epidemiologiccal evidence is against a positive link between coconut consumption and IHD and coconut oil consumption to acute coronary events and stroke. Grated coconut appears to have an additional benefit from both human and animal studies in being able to improve the lipid profile and possibly reduce blood sugar. Further work needs to be done. Attention will need to be paid to the finding that a variant of HDL known as HDL2b, which is found to be significantly lower in patients with ACS than in patients with stable angina and normal subjects. HDL2b is thought to mediate the good effects of HDL, is low in as many as 93% of South Asian men and 63% of women, the effects of coconut oil and coconut fats on sub fractions of HDL will need to be looked at when planning future studies funds permitting.

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