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Effect of Marine Algae on Cholesterol Metabolism in Rabbit

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Brown seaweed species *Cystoseira barbata, Iyengaria stellata* and *Sargassum boveanum* were collected from Karachi coast at Ras Mauri (Capemonze) and Bulleji. Studies have been carried out to determine their fat content and the effect of weed *S. boveanum* diet on the cholesterol level of rabbit serum. To estimate the extent of the effectiveness of seaweed, a parallel study was made with a drug " LOPID" [gemfibroxil; 2, 2-dimethyl-5- (2, 5-Xylyloxy) Valeric acid; (Parke-Davis Corp.)]. The tested seaweed is more effective than the standard drug used.

Key words: *Sargassum boveanum,* Hypo-cholestemic activity, Rabbit serum, Lipid.

Introduction

Coronayry heart disease (CHD), high cholesterol diet and high blood cholesterol level are some well known major problems of the world today (Alia *et al* 1993). Besides cancer and other chronic diseases, the percentage of heart disease is increasing rapidly throughout the world. Although the problem results from several known and unknown factors but the high cholesterol and the high fat diet is a cause of high blood cholesterol level (Dennis 1982; Du and Woodman 1992; Ren *et al* 1994; Rourke and Docherty 1998; Shaiq and Perveen 1998). The hypocholesterolemia is considered a major risk factor for artherosclerosis, almost one half of the people in United States and Europe die because of this disease (Guyton and John 1996). The latest studies have also demonstrated the benefits of lowering cholesterol level on mortality from myocardial infarction (Toshiaki *et al* 1994).

In Indo-Pakistan region Hakims and Vaids, claim for curing hypercholesterolemia through plant source. Besides these marine plants, foods, their isolates are also reported (Takahashi 1986) to exert a positive effect on lowering the blood cholesterol level (Kalhoro *et al* 1994).

Russian scientists have used marine products and marine algae for lowering the cholesterol level in blood plasma (Takashi *et al* 1965; Yunev *et al* 1981; Vita *et al* 1990).

Pakistan coastal area is highly abundant with brown, red and green seaweeds (Usmani *et al* 1985). The toxicity of *Sargassum boveanum* was determined by oral administration in albino mice and albino rats (Clarke and Clark 1975; Loomis 1978; Shahnaz *et al* 1994). Keeping this objective in view, *Sargassum boveanum* was selected to evaluate its hypocholesterolemic action on scientific lines.

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Materials and Methods

Seaweed samples of Phaeophycae family were collected from Ras Mauri and Bulleji, identification was carried out with collaboration of Botany Department and HEJ Institute of Chemistry, University of Karachi. The fresh collected samples of brown seaweeds were washed with fresh water to avoid the unwanted contaminants on it. The washed seaweed was dried in an open space under shade. Ground in a ball mill, the fine powder was passed through sieve of 30-mesh size, fat was extracted by using hexane solvent using Soxhlet apparatus (Shahnaz *et al* 1994).

Feeding experiments on rabbits. Healthy rabbits weighing 1-1.5 kg each, were purchased from a local animal supplier and housed in separate cages for a week and fed on basal diet (gram and leucine). Rabbits were divided into five groups comprised of two animals each. Three experimental group animals were fed with the test brown seaweed *Sargassum boveanum* diet as follow:

Sargassum boveanum was mixed with 250 basal diet (gram and leucine) at a range of 4,8 and 12 g kg^{-1} of body weight per day of the experimental animal groups I, II and III respectively. Lopid (Gemfibrozil) Parke-Davis (Martha *et al* 1983). Dosage 1200 mg in two divided dosage per day for man was mixed with basal diet at a range of 50 mg kg^{-1} of body weight per day of the standard animal group IV. The control group was maintained on the basal diet only (grams and leucine) at room temperature 22-29°C. The animals were

fed daily for six weeks. Blood samples were taken from the ear veins of rabbit of each test, standard and control groups. The cholesterol level in the blood of experimental, standard and control animals was determined at weekly intervals. The cholesterol was estimated using the Liebermann-Burchard reaction (Bhattacharya 1974) by standard graph prepared with known amounts of cholesterol in serum.

Results and Discussion

Diets containing some pulverized seaweeds moderately lowered the lipoprotein marked anti-hypertension and anti-hypercholesterolemic activities.

"Funori" a Japanese found product lowers the plasma cholesterol level when fed to rats, which is a pharmaceutical significance (Champman and Chapman 1980). "Aonori, Nori, Laver" is favourite food and helps for decreasing cholesterol. (Sonia and Gorden 1987). Anti-cholesterolemic Taurine compounds have also been isolated from seaweeds and patented by Takahashi (1986).

The brown seaweed is quoted to have cholesterol lowering effect in metabolism of rats. (Takashi *et al* 1965). There are number of species of brown seaweeds spreaded in the world while *Sargassum* also posses different varieties e.g. *Sargassum boveanum, S. fulrellum, S. fluitans, S. muticum, S. natans, S. swartzii, S. tenerrium, S. valgarae* and *S. wightii.*

S. fluitans and *S. natans* were used and reported to have anticholesterolemic activity in rats (Yunev 1983). *S. valgarae* has also been quoted for its medicinal use (Shaista 1990).

Almost all brown seaweeds including all species of *Sargassum* are reported to contain sterols, eg. ergosterol, chondriosterol, poriferasterol are effective for lowering cholesterol level in rats and rabbits (Chapman 1980). Hence in the light of the work of all these scientists we have selected *Sargassum boveanum* (collected from Bulleji) for our experimental work on rabbits and got positive results for reducing the cholesterol.

Table 1 shows the approximate composition of fat content of brown seaweeds (*Cystoseira barbata, Iyengaria stellata* and *Sargassum boveanum)* collected from Karachi coast, ranging in between 1.39 to 2.86 percentage on dry weight basis, while Fig 1 depicts the picture of cholesterol reducing activity of *S. boveanum* on rabbits. In group-1 the initial cholesterol value was 415.09 at zero time which become 393.49 mg 100 ml^{-1} after two weeks, gradually decreased upto 363.35 mg 100ml^{-1} in rabbit serum. It is quite clear that the cholesterol is decreased to 50 mg 100 ml^{-1}, similarly the decrease of cholesterol level was observed in the animals of group-II. The maximum reduction of serum cholesterol was observed in group-I while minimum was found in group-II. No remarkable change was observed in control group-V. From the results we could easily conclude that the tested seaweed is more effective than the standard cholesterol reducing diet at a dose of 12 mg g^{-1} of lipid.

It is a notable and surprising point that the tested seaweed contains handsome amount of fat which may cause the high cholesterol in blood serum of experimental animal but the results are vise versa. On the other side the point is strengthened when no hypocholesterolemic condition has been reported in rabbits fed on protein isolates having lipid content upto 20.75% such as soybean (Ali *et al* 1993).

Another factor is that polyunsaturated acids (PUFA) eicosapentaenoic acid (EPA) and decosa hexanoic acid (DHA) have been shown an important link to reduce cholesterol. *S.boveanum* also contain hexadecanoic acid.

One more important factor which could not be avoided is the presence of trace metals. Chromium helps the body to cope with sugar link in food. Experiments on rats showed that it were deprived of chromium, developed the symptoms similar to diabetes, had arteries clogged with fat and high level of cholesterol in blood (Sonia and Gorden 1987).

Table 1
Approximate composition of fat content of brown seaweeds collected from Karachi coast

S No	Brown seaweed	Percentage in dry wt		
		Collected from Ras Mauri	Collected from Bulleji	Mean
1.	*Cystoseira barbata*	2.27 2.39	2.40 2.38	2.36
2.	*Iyengaria stellata*	1.38 1.40	1.40 1.38	1.39
3.	*Sargassum boveanum*	2.86 2.84	2.88 2.86	2.86

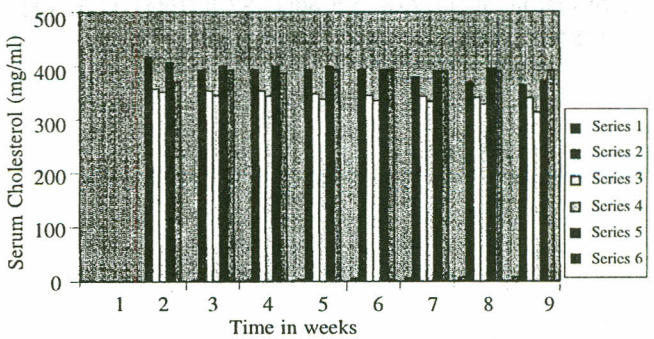

Fig 1. Effect of brown sea weeds (Boveanum) on the Cholesterol in Rabbit.

Zinc has now been recognized as a vital element since it is an essential ingredient for many enzymes. A lack of this element is indicated by slow healing of wound, troubles of prostate gland and arteriosclerosis (Sonia and Gorden 1987). The presence of both trace metals are reported in number of other seaweeds including *S.boveanum* (Shahnaz and Shireen 1994).

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