**Reprint** **ISSN 1997-2571 (Web Version)**

# Journal of Innovation & Development Strategy (JIDS)

*(J. Innov. Dev. Strategy)*

**Volume: 6** **Issue: 2** **December 2012**

*J. Innov. Dev. Strategy 6(2):44-47 (December 2012)*

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**http://ggfagro.com/ejournals/current issues**

JIDS** issn 1997-2571, HQ:19-10 central place, saskatoon, saskatchewan, s7n 2s2, Canada

**ISSN-1997-2571 (Online)**
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# UTILIZATION OF SHRIMP SHELL AS FAT DILUENT

A. NARGIS AND D. TALUKDER

Bangladesh Council of Scientific and Industrial Research Laboratories, Rajshahi, Rajshahi-6206, Bangladesh.

Corresponding author & address: Debashish Talukder, E-mail: dtbcsir12@gmail.com
Accepted for publication on 12 November 2012

**ABSTRACT**

Nargis A, Talukder D (2012) Utilization of shrimp shell as fat diluent. *J. Innov. Dev. Strategy*. 6(2), 44-47.

Shrimp shell contains a chemical called chitin or chitosan which are good source of protein, calcium, phosphorus and minerals. Chitosan is fine chemical used to examine the hypocholesterolemic effect of consuming a supplement containing chitosan in over weight humans. After 45 days of trial with chitosan (1500mg/day) total cholesterol reduction, HDL, LDL and TG were 168, 31.71, 151 and 127.9% respectively. After 90 days, total cholesterol reduction, HDL, LDL and TG were 121, 37.25, 114 and 125% respectively i.e. after 90 days or three months the results are on satisfactory limit.

***Key words:*** *shrimp shell, chitosan, cholesterol and humans*

## INTRODUCTION

A huge quantity of different shrimps shell are carelessly thrown as waste from Chinese restaurants and different fish processing plants especially in the southern districts of Bangladesh. At present, this shrimp shells are only use as cattle feed which has low economic value. Hence, it needs an alternative method to improve the shrimp shell utilization.

One alternative method to utilize shrimp shell is as chitin or chitosan. Chitosan is the deacetylated form of chitin, an amino polysaccharide found in the exoskeleton of arthropods and certain fungi (Furda 1983). In crustacean shell, the chitin content would achieve 20-80% in dry weight (Hargono and Djaeui, 2003). This shell contains a chemical called chitosan, which is a good source of protein, calcium, phosphorus and minerals. Chitosan is a fine chemical in shrimp shell with the percentage of 18% (Suhardi 1993). Many authors reported, that chitosan is used as fat diluents and medicine (Hargono and Djaeui, 2003; Ali *et al.* 2004 and Kelly *et al.* 2003). This chitosan reduces obesity, blood cholesterol and other cardiovascular complications (Jellin *et al.* 2006). According to Bokura and Kobayashi (2003) chitosan decreases total cholesterol in women: a randomized, double-blind, placebo- controlled trial in varied grade.

The objective of the present study was to examine the hypocholesterolemic effect of consuming a supplement containing chitosan in over weight humans.

## MATERIALS AND METHODS

The experiment is conducted in Research Laboratory of Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories Rajshahi, Bangladesh during the month of April to December, 2009. This research was conducted in two steps involving the preparation of chitosan from shrimp shell and the dilution of fat using chitosan product. Freshly collected shrimp shell (500 gm) was washed and sundried. Then it thoroughly grounded in a blender. The powder obtained from shrimp shells were sieved through a 60 – mash sieve. Five hundred gm Shrimp shell produces 200 gm powder. Then salt (3 gm), red chili (2 gm), cumin seed powder (1gm), onion (1gm), ginger (1gm) were admixed together with the powder. It produces 208.5 gm cholesterol reducing powder. Then it packed and air tight in a plastic container.

Oral administration of chitosan powder has been studied in clinical trails for three months. The participants received 1500 mg chitosan powder orally three times per day. Assessments of body weight, blood pressure, quality of life, cholesterol levels occurred at baseline, 45 days and 90 days respectfully. Four participants withdrew from the trial (reasons not given).

The moisture and ash of the sample were estimated by the standard method. Crude protein was estimated by "Micro-Kjeldhal" method. Fat is estimated as crude ether extractives of the dry material. An atomic absorption spectrophotometer (Pye Unicam Sp.9) was used for mineral estimation (Milner and Whitehead 1981). Total cholesterol, LDL and TG were determined by enzymatic and HDL was determined by precipitate method (Mukherjee 1999).

## RESULTS AND DISCUSSION

The moisture, ash, protein and fat contents of this product are 6, 2.3, 49.47 and 4.96% respectively. The calcium, magnesium, sodium and potassium contents are 496, 58, 347 and 328 mg/100 gm (Table 1).

Total study population was 50, among them 31 patients were male and 19 female. All patients were between 30 -69 years of age (Table 2) and body mass indices (BMIS) ranged from 73 to 90 kg/m$^2$. Majority of the patients specimen were hypertensive, other common cardiac risk factors were smoking, diabetes and obesity (Table 3.). After 45 days of trial with chitosan (1500 mg/day), total cholesterol reduction, HDL (High-density lipoprotein cholesterol), LDL (Low-density lipoprotein cholesterol) and TG (Triglycerides) were 168, 31.71, 151 and

127.9% respectively (Table 4). But after 90 days total cholesterol reduction, HDL, LDL and TG were 121, 37.25, 114 and 125% respectively (Table 4). P value of cholesterol, HDL, LDL and TG are significance at 0.05% level. After chitosan trial, HDL in age group 30-39, 40-49, 50-59 and 60-69 were 39.06 ± 1.32, 42.26 ± 1.81, 38.25 ± 1.57 and 37.42 ± 1.60 respectively (Table 5). Triglycerides, after chitosan trial in age group 30-39, 40-49, 50-59 and 60-69 were 170.45 ± 13.77, 376.66 ± 17.34, 145.19 ± 13.12 and 168.65 ± 10.46 respectively. Triglycerides was most markedly reduced in age group between 50-59 (Table 6). Table 7 shows Changes of total lipid profile after two months of treatment with Chitosan. Fig 1 shows comparison of lipid fractions from starting to take chitosan powder up to 90 days.

Table 1. Specification of the Product

| | |
|---|---|
| Moisture | 6% |
| Ash | 203% |
| Fat | 4.96% |
| Iodine value | 66% |
| Calcium | 496mg/100gm |
| Magnesium | 58mg/100gm |
| Sodium | 347mg/100gm |
| Potasium | 328mg/100gm |
| Protein | 49.47% |
| Shelf life | 2 years |
| Color | Pinkish |

Table 2. Age distribution in study population

| Age | Sex | | Total | % |
|---|---|---|---|---|
| | Male N=31 | Female N=19 | | |
| 30–39 | 7 | 3 | 10 | 20 |
| 40–49 | 9 | 7 | 16 | 32 |
| 50–59 | 10 | 8 | 18 | 36 |
| 60–69 | 5 | 1 | 6 | 12 |

Table 3. Distribution of Cardiac Risk Factors

| Risk factors | No. of Patient | % |
|---|---|---|
| Hypertension | 19 | 38 |
| Smoking | 17 | 34 |
| Diabetes | 13 | 26 |
| Obesity | 6 | 12 |

Table 4. Comparison of lipid fractions

| Lipid fractions (Total) | Before starting chitosan (Mean) | After 45 days course of chitosan (Mean) | After 90 days course of chitosan (Mean) | P value |
|---|---|---|---|---|
| Cholesterol | 182 ± 30.27 | 168 ± 8.34 | 121 ± 13.65 | < 0.05 |
| HDL | 28.62 ± 1.63 | 31.71 ± 0.74 | 37.25 ± 2.02 | < 0.05 |
| LDL | 168 ± 7.99 | 151 ± 6.00 | 114 ± 6.27 | < 0.05 |
| TG | 207 ± 19.64 | 127.09 ± 13.19 | 125 ± 14.34 | < 0.05 |

Table 5. Comparison of HDL level before and after chitosan treatment

| | HDL (in mg %) | | | |
|---|---|---|---|---|
| Age group (Years) | Before chitosan trial (Mean ± SD) | After chitosan trial (mg % ) (Mean ± SD) | % of augmentation | P value |
| 30–39 | 35.34 ± 2.88 | 39.06 ± 1.32 | 9.52 | P<0.01 |
| 40–49 | 37.36 ± 0.89 | 42.26 ± 1.81 | 11.59 | P<0.001 |
| 50–59 | 32.31 ± 1.97 | 38.25 ± 1.57 | 15.52 | P<0.001 |
| 60–69 | 34.89 ± 2.15 | 37.42 ± 1.60 | 6.76 | P<0.001 |

Table 6. Comparison of TG level before and after chitosan treatment

| | TG (in mg %) | | | |
|---|---|---|---|---|
| Age group (Years) | Before chitosan trial (Mean ± SD) | After chitosan trial (mg% ) (Mean ± SD) | % of reduction | P value |
| 30–39 | 225.85 ± 14.87 | 170.45 ± 13.77 | 22.50 | P<0.001 |
| 40–49 | 598.61 ± 16.84 | 376.66 ± 17.34 | 37.06 | P<0.001 |
| 50–59 | 261.59 ± 15.57 | 145.19 ± 13.12 | 44.48 | P<0.001 |
| 60–69 | 242.18 ± 13.97 | 168.65 ± 10.46 | 30.36 | P<0.001 |

Table 7. Changes of total lipid profile after two months of treatment with Chitosan

| Lipid profile (mg %) | % of reduction |
|---|---|
| Cholesterol | 33.51 |
| HDL | 22.88 |
| LDL | 32.14 |
| TG | 38.33 |

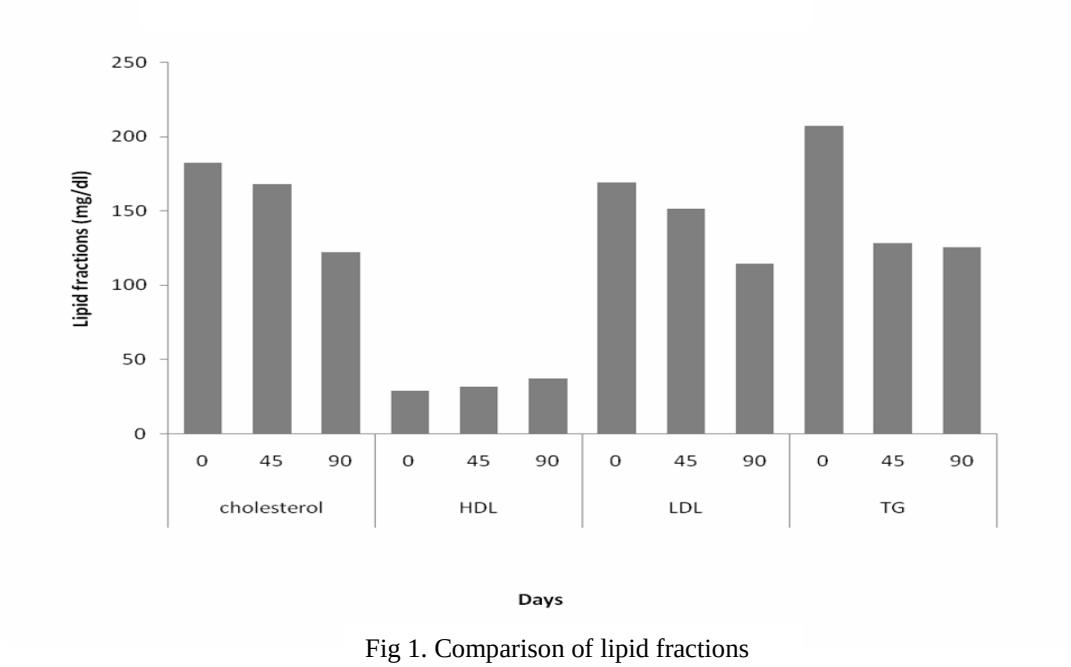


Fig 1. Comparison of lipid fractions

Proximate analysis of commercial shrimp waste indicated the presence of 94.6% protein and 4.2% fat on dry weight basis. The HPLC analysis referred to the presence of 17 amino acids and 7 sugars (Ibrahim *et al.* 1999). Chitosan is one of the multitudes of weight loss products to emerge. It differs from many dietary supplements in that it is not claimed to increases energy expenditures (Milka and Patana, 2002). Chitosan has also been claim to reduced cholesterol, improve anemia, enhance physical strength and promote sleep (Jellin 2006).

Shrimp's waste (dried head or shell) was found of high protein content and high level of minerals especially Ca, P, Na and Zn (Ibrahim *et al.* 1999). Numerous observation epidemiologic studies, laboratory investigation studies in laboratory animals and genetic forms of hyper lipodemia provide evidence for this connection (Gotto and Grudy, 1996; Farmer and Gotto, 1994). Chitosan is believed to effect cholesterol levels and weight because it has positively charged amino group at the same pH as the gastrointestinal tract (DerMarderosian and Beutler, 2002).

Deuchi *et al.* 1994 reported that chitosan greatly reduces fat digestibility in rats and chickens when fed at 5% and 1.5% of the diet respectfully. Bokura and Kobayashi (2003) worked especially in elderly women and suggested that chitosan is safe and significantly reducing serum total cholesterol. The effect of chitosan on decreasing total and LDL cholesterol is mild. Gallaher *et al.* (2000) and Deuchi *et al.* (1994) confirms the hypocholesterolemic effect of a chitosan and glucomannan supplement reported in rats, chickens and extends the finding to humans. Daniel *et al.* (2002) also reported that glucomannan and chitosan fiber supplement decreases plasma cholesterol and increases cholesterol excretion in over weight normocholesterolemic humans.

## CONCLUSION

Our results suggest that Chitosan is a safe and significantly act in the fats dilution process in over weight humans. This cholesterol reducing agent is hygienic and it did not produce any adverse effect or allergy in human body. Thus it would have the potentiality as a substitute of imported medicines of this disease that will save our much needed hard earned foreign currency.

## ACKNOWLEDGMENT

The authors express their gratitude to Dr. Husna Pervin Nur, Director, BCSIR Laboratories, Rajshahi for providing all research facilities. The authors also express their sincere thanks to Chairman, BCSIR, for his kind Co-operation.

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