Reducing Effect of Feeding Powdered Nacre of *Pinctada maxima* on the Visceral Fat of Rats


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An abdominal fat accumulation complicated by high blood triglycerides is regarded as a risk factor of metabolic syndrome. Feeding powdered nacre, mother of pearl, from *Pinctada maxima*, resulted in reduced body weight, visceral fat amount, and blood triglyceride level without influencing the food intake, body length, or amount of muscular tissue, suggesting that nacre powder specifically could decrease visceral fat.

Key words: nacre; visceral fat; triglyceride

Mother of pearl (nacre) is a composite consisting of calcium carbonate crystals in an aragonite structure, embedded in an organic matrix. Nacre is obtained from the inner shell layer of the giant oyster, *Pinctada maxima*, and ground to superfine powder by Mikimoto Pharmaceutical Co. (Ise, Japan) in order to obtain particles with a mean size 2.2 μm in diameter. This superfine powder contains inorganic material of 38% (w/w) calcium carbonate, as aragonic crystals, and a 2.2% organic matrix which is mainly built up with silk-like proteins rich in glycine, alanine, aspartic acid and leucin. Nacre has shown several interesting biological activities such as osteogenic activity and an ability to protect the skin. Nacre was able to activate and attract osteoblasts in both *in vivo* and *in vitro* experiments. Bone formation is thought to begin with the recruitment of mesenchymal stem cells which differentiate to form osteoblasts. When nacre is implanted in bones, new bone formation occurred without any inflammation reaction. Moreover, implanting nacre powder in animal skin has resulted in enhanced activity of fibroblasts and synthesis of the dermal extracellular matrix.

In the process of investigating the features of nacre powder, we have found it to possess novel interesting biological activity: reducing ability for visceral fat. Visceral fat accumulation has a pathophysiological role in the development of metabolic syndrome which is characterized by the coexistence of atherogenic risk factors, including obesity, hyperlipidemia, diabetes, and hypertension, combined with underlying insulin resistance. This study demonstrates for the first time that nacre powder is capable of reducing the body weight, amount of abdominal fat, and blood triglyceride level in animals.

All procedures were performed according to Japanese national guidelines (Notification No. 6, March 27, 1980 from the Prime Minister’s Office). Eight-week-old male Wistar rats were purchased from Japan SLC (Shizuoka, Japan), measured for their body weight and length (from the nose tip to the tail root) at 9 weeks of age, and assigned to two groups so that there were no differences in these parameters. To the control group (*n* = 8) was given a standard powdered diet (MF: 360 kcal/100 g, Oriental Yeast Co., Tokyo, Japan). To the nacre food group (*n* = 9) was given the standard powdered diet containing 5% nacre powder (nacre food). Food and water were provided *ad libitum*.

As shown in Fig. 1, after 39 d of nacre food consumption, the body weight of the nacre food group was significantly lower than that of the control group. The total calorie intake was calculated from the food intake. There was no significant difference in food intake during the administration period between the control (mean ± SD, 3,521 ± 15 kcal) and nacre food (3,501 ± 16 kcal) groups. After 39 d of diet ingestion, the mean values for the body length of the control and nacre food groups
triglyceride level without reducing the food/calorie intake. In addition, the nacre powder ingestion did not influence the body length or amount of muscular tissue in the test animals, suggesting that this powder could specifically decrease body fat, especially visceral fat.

Pears, which are produced by the same mechanism as that for shells, have been utilized not only as accessories but also as a traditional Chinese herbal medicine. A protein fraction contained in pearls (content of 2–3%), conchiolin, seems to activate cutaneous fibroblasts2,8) and is employed as an ingredient of cosmetics. Rousseau and coworkers have extracted lipids from nacre powder, and is employed as an ingredient of cosmetics. Rousseau et al. have suggested that an organic component of the powder obtained from scallop shells, which are produced by the same mechanism as that for scallop shells, have been utilized not only as accessories but also as a traditional Chinese herbal medicine. A protein fraction contained in pearls (content of 2–3%), conchiolin, seems to activate cutaneous fibroblasts2,8) and is employed as an ingredient of cosmetics. Rousseau and coworkers have extracted lipids from nacre powder, and is employed as an ingredient of cosmetics. Rousseau et al. have suggested that an organic component of the powder obtained from scallop shells, which are produced by the same mechanism as that for
pears, decreased body fat. To exclude the influence of calcium carbonate, comprising 95% or more of shells, they administered a diet containing calcium carbonate at the same content (3.3%) as the scallop shell powder content of a standard powdered diet to control rats, and compared the fat weight between the control rats and those fed on the scallop shell powder-containing diet.10) The cervical, retroperitoneal, and mesenteric adipose tissue weights of the scallop shell powder group were all significantly decreased. These results are similar to those of this present study. However, in our study, the calcium carbonate content in the control group was 1.2%, whereas the nacre powder content in the nacre food group was 3.1%. Moreover, the scallop shell powder induced gene expression of uncoupling protein 1 (UCP1) which regulates energy metabolism in the white adipose tissue of animals.11) Judging from these findings together with the beneficial effects of nacre powder on skin fibroblasts2) and on differentiated cells of the epidermis,3–8) an attractive source of bioactive molecules (proteins and lipids) could be contained in nacre powder to decrease the blood level of triglycerides and the amounts of visceral fat and subcutaneous fat, at least in part, by regulating energy metabolism.

Visceral fat accumulation complicated by elevated triglycerides is regarded as a high risk factor for the metabolic syndrome.6,7) In the near future, the physiologically active substances involved in the nacre powder-related decreases in the amount of visceral fat and blood level of triglycerides should be clarified, as well as the mechanism of action.

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References