MASSEY UNIVERSITY

RESEARCH STUDIES OF FISH BONE POWDER – CONTAINING CALCIUM

Summary report

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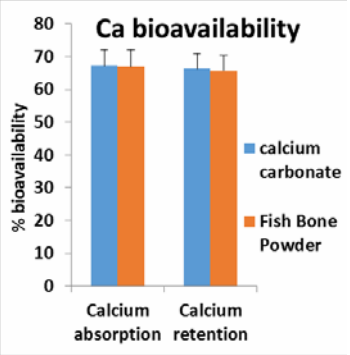
December 2016

MASSEY INSTITUTE OF FOOD SCIENCE AND TECHNOLOGY

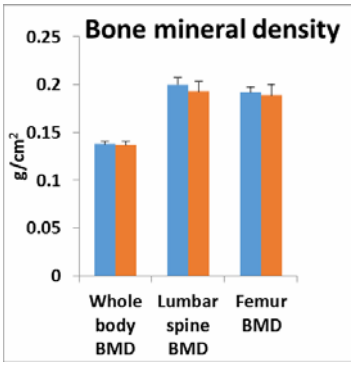
meeting global challenges of the 21st century

Taking calcium carbonate alone in the form of a tablet or supplement is not fully effective in preventing reducing bone loss and risk of fractures and also increases the risk of cardiovascular disease. Thus, there is growing interest in creating calcium-fortified foods to aid consumers in meeting their daily calcium intake requirements. Fish bone powder produced by United Fisheries was compared to calcium carbonate for bioavailability and function in a series of rat models. Calcium carbonate is the standard reference calcium source for digestibility studies.

The fish bone powder product was comprised of approximately 25% calcium, 13% phosphorus, 25% protein, and 14% collagen, with the remainder being other minerals. It was thus a more complex mixture than calcium carbonate, a simple calcium-containing compound commonly sourced from marine organism shells, rocks, and agricultural lime. The fish bone powder product was tested in three animal models: adolescent rats, adult rats, and post-menopausal rats.



In young growing male rats fed diets containing fish bone powder or calcium carbonate for four weeks, the fish bone powder product matched calcium carbonate in bioavailability. Both absorption of calcium from the gut and retention of calcium within the body were as high with fish bone powder as with the standard calcium carbonate.

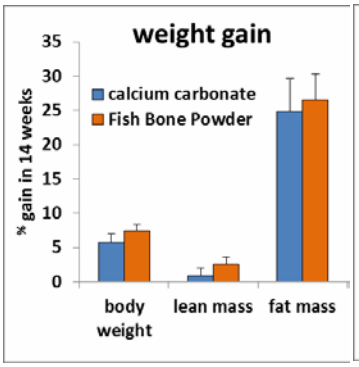


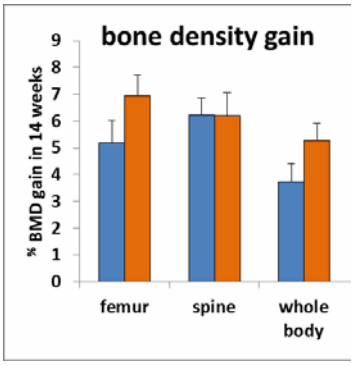
Similarly, the function of the absorbed calcium from fish bone in laying down new bone was as effective in adolescent rats compared to calcium carbonate. Mineral densities in the spine and femur, as well as in the combined bones in the whole body, were similar in the two test groups.

The fish bone powder did not adversely affect growth of the adolescent rats or other health parameters. Both fish bone powder and calcium carbonate-fed rats ate and grew at the same rate, doubling their body weights within four weeks, and had matching levels of lean mass (>80%).

In mature normal adult female rats, the same comparable efficacy was observed for the fish bone powder compared to calcium carbonate. Adult rats fed diets containing fish bone powder or calcium carbonate for three months ate similar amounts of food (251 vs 254 kJ per day) and maintained their body weights at

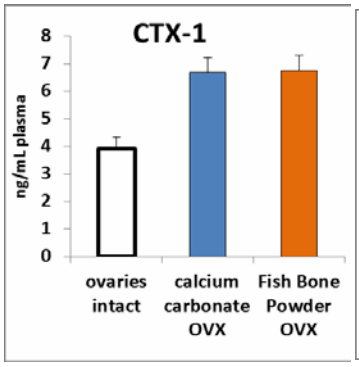
similar rates. As expected, most of the weight gain experienced by these sedentary adult female rats was in the form of fat mass rather than lean mass.

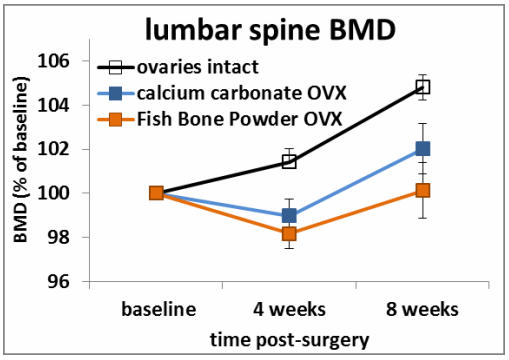




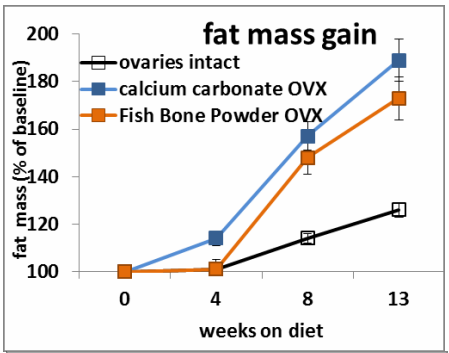
The rate of gain in bone mineral density in the rats fed fish bone powder was similar in the spine, which is the key location where loss of bone mineral density correlates with the development of osteoporosis. Bone mineral density gain in the femur and whole body of fish bone powder -fed rats was slightly greater than the comparative calcium carbonate-fed rats.

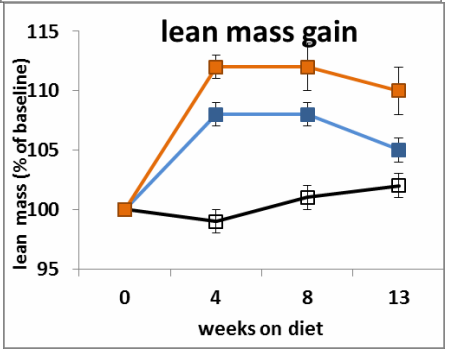
In adult female rats, osteoporosis begins to develop if the ovaries are surgically removed and oestrogen levels drop, mimicking menopause. This is observed in both a loss of bone mineral density and a rise in the plasma levels of the bone turnover marker known as CTX-1. The CTX-1 blood levels in rats post-ovariectomy were nearly double those of rats that did not undergo surgery, as expected. Likewise, rats lost spine bone mineral density within 4 weeks after ovariectomy, unlike rats that did not undergo surgery (sham). Both the rate of CTX-1 increase and the rate of bone loss after ovariectomy were similar in rats fed fish bone powder compared to calcium carbonate.





The amount of food offered to the female rats was limited to the recommended maintenance level, so there was no more than 10% difference in kilojoule intake between ovariectomised rats and their non-surgical counterparts. However, whereas the non-surgical rats gained 6% of their body weight over 14 weeks, the ovariectomised rats gained 21% of their body weight, due to the change in metabolism induced by menopause. Interestingly, the presence of fish bone powder in the diet slowed the rate of gain in fat mass and





significantly increased the rate of gain in lean mass in the ovariectomised rats without affecting food intake.

In the three animal studies conducted at Massey University, the United Fisheries fish bone powder was equivalent to calcium carbonate as a dietary source of calcium when incorporated into food. The calcium in the fish bone powder product was highly bioavailable and was comparable to calcium carbonate in producing new bone during adolescence. In normal adults, the calcium present in the fish bone powder was equivalent or superior to calcium carbonate in maintaining bone mineral density. In post-menopausal females, the fish bone powder calcium matched calcium carbonate in limiting bone loss.

Additionally, the research conducted on the fish bone powder demonstrated a bioactive property that improved lean mass gain and reduced fat mass in the post-menopausal female. It is likely that this effect was due at least in part to the proteins and/or collagen in the fish bone powder product that are not present in calcium carbonate.

The United Fisheries fish bone powder is suitable for use to fortify food products with calcium as an alternative to calcium carbonate, and may provide additional health benefits that calcium carbonate alone does not.