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Innovative nutritional strategies to preserve bone health: The role of fish oils supplementation in counteracting senile osteoporosis

Keywords: Osteoporosis, aging, nutrition, lipids, SAMP8, inflammation

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Scientific question:

The aim of this study was to analyze the **impact of fatty acid quality on the age related establishment of osteoporosis**. The SAMP8 mouse strain was chosen as a progeria model as compared to the SAMR1 control strain. Two months old mice were divided in different groups and subjected to the following diets : (1) standard "growth" diet – (2) "sunflower" diet (high $\omega 6/\omega 3$ ratio) – (3) "borage" diet (high γ -linolenic acid) – (4) "fish" diet (high in long chain $\omega 3$). Mice were fed *ad libitum* through the whole protocol. At 12 months old, bone and fat masses were measured, inflammation parameters and bone cells markers expression were investigated. **We demonstrated for the first time that borage and fish diets restored inflammation and bone parameters using an original model of senile osteoporosis that mimics clinical features of aging in humans. Therefore, our study strongly encourages nutritional approaches as relevant and promising strategies for preventing aged-related locomotor dysfunctions.**

Figure 1 Experimental protocol design:

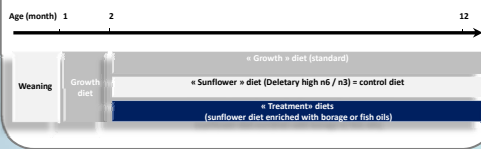


Table 1: Diets formulations

Ingredient (g/100g diet)	standard diet (Harlan 2019)	sunflower based diet	borage enriched diet	fish enriched diet
wheat starch	55.24	59.14	56.79	56.79
casein	19.00	19.20	19.20	19.20
sucrose	4.16	4.16	4.16	4.16
fiber cellulose	3.60	3.50	3.50	3.50
DL Méthionine	3.30	0.30	0.30	0.30
Choline bitartrate	0.20	0.20	0.20	0.20
Mineral mix ¹	3.50	2.50	2.50	2.50
Vitamin mix ²	1.00	1.00	1.00	1.00
sunflower oil	0.00	5.45	5.62	6.73
canola oil	0.00	2.73	3.37	3.37
borage oil	0.00	0.00	2.79	0.00
fish oil	0.00	0.00	0.00	1.68
oleisol oil	0.00	1.82	0.57	0.57
soybean oil	10.00	0.00	0.00	0.00
energy (cal)	420	428	440	440

Figure 2 Bone status (Sf: Sunflower diet; Bo: borage diet; Fi: fish diet). Significant different groups are represented by different letters as analyzed by ANOVA ($p < 0.05$).

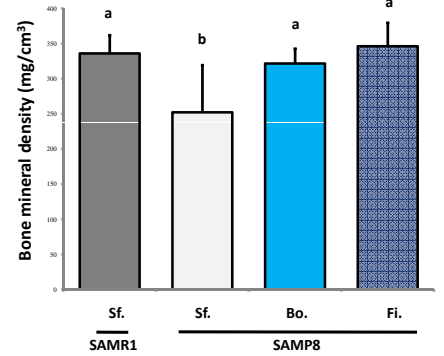


Figure 3 Weight tissues: A: Total body weight gain over the complete study. B: Food intake. C: Quadriceps weight. D: Visceral adipose tissues weight. (Sf: Sunflower diet; Bo: borage diet; Fi: fish diet). Significant different groups are represented by different letters as analyzed by ANOVA ($p < 0.05$).

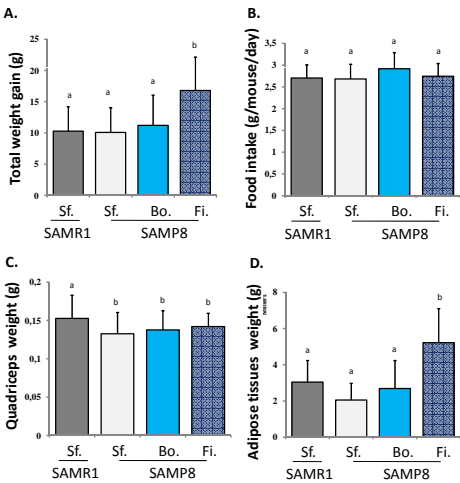


Figure 4 Expression of bone cell markers (A and B: pro-resorbing markers; C and D pro-forming markers) determined by transcriptomic analysis on bone tissues. (Sf: Sunflower diet; Bo: borage diet; Fi: fish diet). Significant different groups are represented by different letters as analyzed by ANOVA ($p < 0.05$).

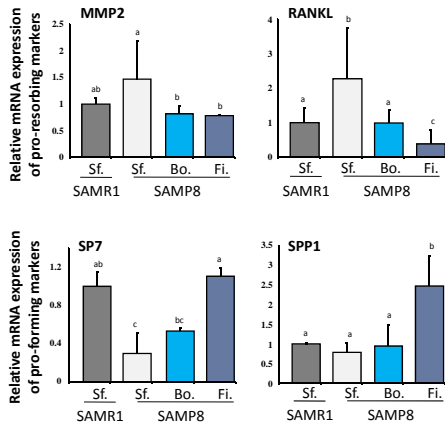
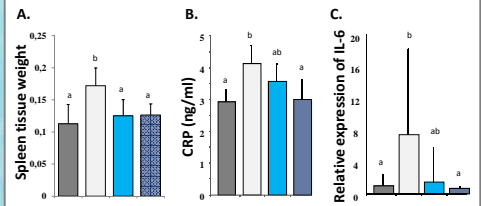


Figure 5 Inflammation parameters: A: Spleen weight measurements. B: C-reactive protein analysis in blood samples. D: Expression of IL-6 transcripts in bone tissues (tibiae). (Sf: Sunflower diet; Bo: borage diet; Fi: fish diet). Significant different groups are represented by different letters as analyzed by ANOVA ($p < 0.05$).



Better fat quality,

Better aging

Better bone health,

