

Title of the invention

CALCIUM ENRICHED SEAFOOD PRODUCT

Field of the Invention

5 The field relates to the food processing science and technology, especially in the field of the production of calcium enriched seafood product, preferably the enrichment of shelf stable, chilled, or frozen fish product with calcium.

Description of the Related Art

10 Calcium is the fifth most abundant element in the human body. It plays an important role in many physiological processes, including nerve and muscle functions. Furthermore, calcium is required for a normal growth and the development and maintenance of the skeleton which provides strength and structure of the body.

Over 99% of total body calcium is found in the teeth and bones. As bone contains a high proportion of the body calcium, it is the major reservoir for calcium in most vertebrates and the main component of bone calcium is hydroxyapatite.

15 Typically, tuna product, especially canned tuna, contains only meat without bone. This causes the low calcium content per can of the products. Other shelf stable tuna products in the market also contain very low quantity of calcium. The enrichment of calcium in food products such as functional beverages with fish bone extract (CN103719990A), fish bean curd supplemented with calcium lactate (CN101032311A), fish ball with addition of fish bone paste (CN102551108), fish
20 meat blend sausage or sausage with addition of bone powders obtained from fish (CN102078004), beef or pork bones, seafood soup with supplementation of ground fish bone (CN104041869) and yogurt with fishbone supplement (CN104041586A) have been reported previously. Other relevant patent documents are: CN1315145, JP-S-60-259163, JP-H04-190768, and JP 2003/225070.

Larden et al (2000) reported that the intake of whole small fish with bone can increase calcium bioavailability and the small fishes may be an important source of calcium.

Tuna bone, similar to any other animal bones, is a good source of natural calcium, mainly composed of calcium and phosphate in the form of hydroxyapatite $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ crystal and other ions. The organic phase of the bone is composed of collagen fibers, and ground substances formed by glycoproteins and proteoglycans (*Prentice et al. 2003*). This makes tuna bone and the partial composition thereof the preferred sources of natural calcium used for the addition or enrichment in the seafood products.

This invention is intended to improve nutritional values, properties and characteristics of shelf stable tuna or salmon products or other similar shelf stable, chilled or frozen fish products by adding fishbone powder such as ground tuna bone, tuna bone powder or the partial composition thereof to tuna or salmon products or other similar shelf stable, chilled or frozen fish products. The said tuna or salmon products or other similar shelf stable, chilled or frozen fish products with added tuna bone or the partial composition thereof are known as calcium enriched products which can provide the health benefits to the consumers similar to or superior to the consumption of whole tuna (meat with bone) products.

This invention, therefore, yields calcium enriched seafood products, including the categories of shelf stable, chilled or frozen tuna or salmon products that can provide bone health benefit to consumers. Typically, the calcium enriched products are designed to provide at least 10% of RDI by adding calcium derived from tuna bone.

Summary of the invention

This invention relates to the calcium enriched seafood products, tuna or salmon flake, tuna or salmon chunk, tuna or salmon shred, tuna or salmon steak or tuna meat or salmon meat in other forms which are preserved in different media such as brine, vegetable oil, spring water or savory gravy; tuna or salmon spread or other similar products made from tuna meat or salmon meat. The sources of calcium used for addition or enrichment in said shelf stable products can be selected from the raw or partially purified animal or fish bones or inorganic calcium compounds.

The preferred animal bones included chicken, swine or beef bones. The preferred fish bones are tuna, salmon or trout bones. Furthermore, the said bones may be purified or partially purified in order to remove other bone components except for calcium. In this invention, the calcium obtained from tuna bone is referred to as “tuna calcium” or micronized particle tuna bone powder.

5 **Brief Description of the Drawing**

Specific implementations of the invention will now be described with reference to the following tables, which are provided by way of example, and not limitation.

Table 1 is showing the result of fill weight and drain weight after sterilization of canned tuna flake in brine;

10 Table 2 is showing the sensory property of calcium enriched canned tuna flake in brine;

Table 3 is showing the result of drained weight after sterilize and calcium content of canned tuna flake in soya oil;

Table 4 is showing the sensory properties of canned tuna flake in soya oil;

15 Table 5 is showing calcium content of canned tuna flake in brine with different amount of tuna bone powder;

Table 6 is showing calcium content of canned tuna flake in brine with added Di-calcium phosphate; and

Table 7 is showing calcium content of canned tuna flake in soya oil with added tuna bone powder.

Detailed description of the invention

20 Shelf stable seafood products include the seafood products that can be safely stored at a room temperature in any form of sealed containers such as can, pouch or plastic cup. The preferred examples of the shelf stable seafood products according to this invention are tuna or salmon in can, retort pouch or plastic cup.

Chilled seafood products according to this invention mean the seafood products that need to be stored at refrigerated temperatures (at or below 0 – 4 °C) in order to maintain the product quality and microbiological safety at the point of consumption. The preferred examples of the chilled seafood products are tuna steak or fillet; salmon steak or fillet.

5 Frozen seafood products according to this invention means the seafood products that are preserved by freezing and need to be stored at the temperature below -18 °C in order to maintain the highest product quality and microbiological safety. The preferred examples of the frozen seafood products are precooked tuna loin or flake; frozen salmon fillet.

10 The calcium enriched seafood products according to this invention includes but not limited to the shelf stable products, chilled or frozen tuna or salmon flake, tuna or salmon chunk, tuna or salmon shred, tuna or salmon steak or tuna meat or salmon meat in other forms which are preserved in different media such as brine, vegetable oil, spring water or savory gravy; tuna or salmon spread or other similar products made from tuna meat or salmon meat. The shelf stable products according to this invention also includes the similar products made from other fishes.

15 The sources of calcium used for addition or enrichment in said shelf stable products can be selected from the raw or partially purified animal or fish bones or inorganic calcium compounds. The preferred animal bones included chicken, swine or beef bones. The preferred fish bones include but not limited to tuna, salmon or trout bones. Furthermore, the said bones may be purified or partially purified in order to remove other bone components except for calcium. In this

20 invention, the calcium obtained from tuna bone is referred to as “tuna calcium” or micronized particle tuna bone powder.

Other sources of calcium used for addition or enrichment in said products according to this invention can be selected from the group of inorganic calcium compounds such as calcium carbonate, calcium phosphate, calcium sulfate and calcium chloride or combination thereof.

25 The preferred amount of calcium added in said products is in the range of 0.25-0.95% (w/w) of the total weight of said products.

The seafood products according to this invention, preferably tuna or salmon products, exhibits improved qualities, including, but not limited to texture and water holding capacity. The examples below provide example experiments which the selected tuna products are enriched with certain forms of calcium and it is not meant to be the limitation of this invention. Any person with skills in the art should realize that shelf stable products according to this invention can be made from other fishes.

Experiment 1:

This experiment shows the effect of calcium enriched tuna flake in brine and soya oil in aspect of product characteristic and nutritional value.

Preparation and testing of canned tuna sandwich (flake) in brine or soya oil media with calcium enrichment. In order to prepare the canned tuna sandwich in brine or soya oil media with calcium enrichment, the detailed process is listed below;

Method:

- Mixing precooked skipjack tuna flake having size ranging from 1-2 cm with a tuna calcium particle size of less than 100 microns (micrometers) or in the range of 0.1-30 microns, but most preferably at 10 micron, and a calcium phosphate. The amount of calcium added in the finished product is in the range of 0.5-5% (w/w), but most preferably in the range of 1-2% (w/w) of the total weight of said products; and

-Packing said calcium enriched tuna product obtained from the previous step in a can before sterilizing with a retort process . The said product was examined for fill weight and drain weight and the weight difference (%) was calculated as shown in table 1. The calcium content of the finished product was analyzed by ICP emission spectrometry AOAC (2012), 984.27.

The appearances and sensory evaluation of tuna products after calcium enrichment with 1.5 and 1.7 % (w/w) tuna bone powder and 1.7% of di-calcium phosphate are examined with the comparison of the control as shown in table 2.

According to this experiment, the calcium enrichment in tuna products results in the increase of product yield after sterilization in both fill media (i.e. brine and oil) of 5-7.5% (w/w), preferably of 6.6-7.5% (w/w) of the total weight of the product (tables 1 and 3). The sensory qualities of calcium enriched canned tuna flake have been improved especially for moisture and firmness of the product when compared to the control (tables 2 and 4). With micronized particle size, the sandy or chalky texture cannot be detected in the product. The effect of amount of tuna bone added on the calcium content of the final products is shown in tables 5 and 7. The calcium content of the final products after added with di-calcium phosphate is shown in table 6. From this experiment, it is clearly indicated that the calcium content of the canned tuna products both in brine and soya oil were increased significantly after enriched with tuna bone powder or inorganic calcium compound (tables 6 and 7). The calcium enrichment of tuna product by adding tuna bone powder in the amount of 1.5-2.0% (w/w) of the total product yields high calcium content in the said tuna products after drained (table 5). Namely, the calcium enrichment of tuna product containing the available calcium in the approximate range of 150-411.8 mg/100 g. This suggests that the calcium enrichment either by adding tuna bone powder or inorganic calcium compound is highly suitable for making calcium enriched fish products, especially, tuna products which are unprecedented.

It is important to note that the target calcium content per 100g of product in the selected countries is listed below. Target Calcium content per 100g product:

- EU: 120-300mg/100g
- TH : 120-300mg/100g
- USA: 185-300mg/100g

Additionally, the Thai Recommend Daily Intake; Codex Nutrient Reference Value and the US Recommended Daily Intake are 800mg, 800mg, and 100mg, respectively.

Claims

1. A calcium enriched seafood product comprising an additional calcium supplement, wherein:
 - 5 - said enriched seafood product is prepared from tuna or salmon,
 - said enriched seafood product is in the form of flake, shredded, chunk or steak,
 - the amount of said additional calcium supplement is in the range of 0.5 to 5.0 % (w/w) of the total weight of said product, and
 - said additional calcium supplement is:
 - 10 - a fish bone powder selected from tuna, salmon or trout bone powder, or
 - inorganic calcium compound selected from the group of calcium carbonate, calcium phosphate, calcium sulfate and calcium chloride or combination thereof.
2. The calcium enriched seafood product according to claim 1, wherein the amount of said
15 additional calcium supplement is in the range of 1 to 2 % (w/w) of the total weight of the product.
3. The calcium enriched seafood product according to claim 1 or 2, wherein said fish bone powder is selected from salmon or tuna bone powder.
- 20 4. The calcium enriched seafood product according to claim 3, wherein said fish bone powder is tuna bone powder.
5. The calcium enriched seafood product according to any preceding claim, wherein said bone
25 powder has a particle size lower than 100 microns.
6. The calcium enriched seafood product according to claim 5, wherein said bone powder has a particle size of 0.1 to 30 microns.
- 30 7. The calcium enriched seafood product according to claim 6, wherein said bone powder has a particle size of 10 microns.

8. The calcium enriched seafood product according to claim 1 or 2, wherein said inorganic calcium compound is di-calcium phosphate.

9. The calcium enriched seafood product according to any preceding claim, wherein the amount of calcium is in the range of 150 to 411.8 mg/100g of the product.

10. The calcium enriched seafood product according to any preceding claim, wherein said calcium enriched seafood product can be a shelf stable product, a chilled fish product or a frozen fish product.

11. The calcium enriched seafood product according to any preceding claim, wherein said product further comprises filling media selected from the group of brine, vegetable oil, spring water or savory gravy.

12. The calcium enriched seafood product according to claim 11, wherein said product is selected from flake in oil, flake in brine, and spread.

13. The calcium enriched seafood product according to any preceding claim, wherein said product is prepared from a tuna selected from Skip Jack, Yellow fin, Albacore or Big eye species.

14. The calcium enriched seafood product according to any preceding claim, wherein said product is packed in a packaging container selected from the group of can, pouch or plastic cup.

15. The calcium enriched seafood product according to claim 4, wherein said product is canned tuna flake and wherein said tuna bone powder is added to an amount within the range of 1.5 to 2 % (w/w) of said product.