

facts



Adding value to surimi
based products

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Leading experts
in the technology of mineral salts

Adding value to surimi

In Japan there are documentary references to the seafood known as surimi going back to 1115. ^[1] Surimi, which means “ground meat” in Japanese, refers to a paste made from fish meat. White fish such as Alaska pollock and threadfin bream are gutted, filleted, deboned, refined and mixed with cryoprotectants before freezing to produce this paste.

In 2016 the global surimi market volume exceeded 1.5 million tons a year, with China, Vietnam and USA each contributing 20% to global production. Surimi and its products are a familiar part of Asian cuisine; Japan leads consumption, with around 500,000 tons per year. While Asian markets remain the main drivers of consumption, surimi is becoming increasingly popular in other regions too. This development is accompanied by demands for higher quality, standardization and additional health benefits like mineral fortification and sodium reduction. SALT Minerals, a producer of ingredients obtained by fermentation, has been exploring how innovative applications could provide tastier, healthier options for the surimi industry.

Health: Sodium reduction

Consumers are increasingly moving towards healthier lifestyles, with a focus on wellness and wellbeing. Conversely they want to spend less time preparing meals and more time doing things they value. Busy lifestyles, woman in the workforce and the aging population all influence consumer demand for processed food. However, processed food usually contains high levels of sodium. A diet high in sodium and low in potassium adversely affects blood pressure and increases the risk of heart disease and stroke. According to the World Health Organisation, 2.5 million deaths could be prevented each year if global sodium consumption could be reduced to the recommended < 2 g of sodium per day (corresponding to 5 g of salt). Yet global average consumption is currently 9–12 g of salt per day, and therefore twice the general recommendation.

In surimi, salt has a fundamental function. It not only imparts flavour, it also give the paste its desirable smooth texture and gelling properties. Salt ions selectively bind to the negatively charged groups on protein surfaces and break the intermolecular ionic bonds, thus increasing the affinity of the proteins to water. This helps to disperse proteins and increases water-holding capacity. Added salt contributes up to 80–90% of the total sodium in surimi. Thus raw surimi contains around 150 mg of sodium per 100 g, but adding the extra 1.5–3% of salt needed to produce processed surimi seafood products can take their levels up to 800–1,200 mg sodium per 100 g. Reducing the amount of salt in surimi reduces saltiness but it also affects extraction and stability, which in turn affects its cooked texture. SALT Minerals offers a range of salt substitutes under the brand name sub4salt[®]. This is a mixture of sodium chloride and potassium salts designed to reduce sodium content by up to 43% (table 2) without compromising the taste and texture of products. sub4salt[®] can be used to replace salt on a 1:1 basis, keeping the same saltiness and functionalities. Replacing salt with sub4salt[®] N1000 or sub4salt[®] plus 50 in a basic surimi sausage formulation leads to a 15–33% increase in hardness (expressed as breaking strength), and 5–13% increase in cohesiveness (expressed as distance to rupture). This can be attributed to the potassium ions present in sub4salt[®], which enhance protein solubility and gelation better than sodium ions (Hofmeister series ^[2]). Using a product like sub4salt[®] not only has an impact on the healthiness of surimi products but also improves their texture without compromising on taste.

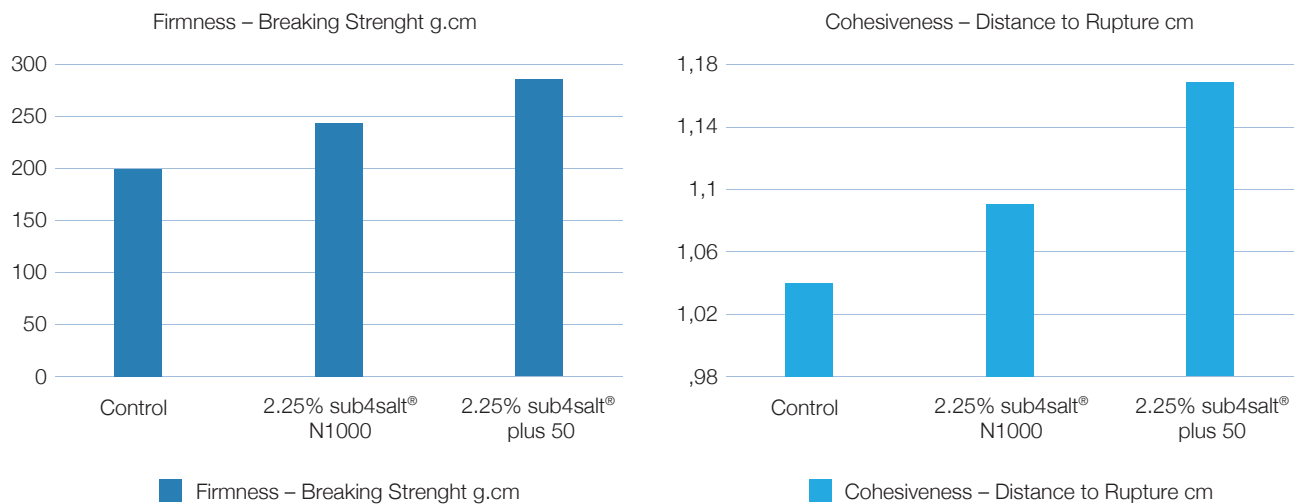
Table 1: Basic surimi sausage formulation

Ingredients	%
Raw Surimi	50.00
Salt	2.25
Potato Starch	4.00
Sugar	0.40
MSG	0.20
Water	43.15
	100.00

Table 2: Sodium reduction of a surimi sausage

Salt used	mg Sodium/ 100 g surimi sausage	% Sodium reduction compared to use of salt in surimi sausage
2.25% NaCl	1.000	
2.25% sub4salt® N1000	700	30
2.25% sub4salt® plus 50	566	43

Figure 1: Firmness and cohesiveness of surimi sausage with sub4salt®.
 Texture analysis was conducted using a Stable Microsystems TA XT-plus Texture Analyser
 (penetration test using 5mm spherical probe, speed of 1.1mm/s, distance of 15mm with a 5kg load cell).



Health: Calcium fortification

Annually, osteoporosis causes more than 8.9 million fractures worldwide. ^[3] The risk of developing osteoporosis is strongly linked to low dietary calcium intake. Osteoporosis is especially prevalent among Asians, whose consumption of dairy products is lower due to lactose intolerance. Surimi in the form of surimi sausages is a popular snack in Japan, South Korea and China. This wide acceptance and consumption makes it an ideal vehicle for effective calcium fortification to prevent calcium deficiency, in particular in children and elderly women.

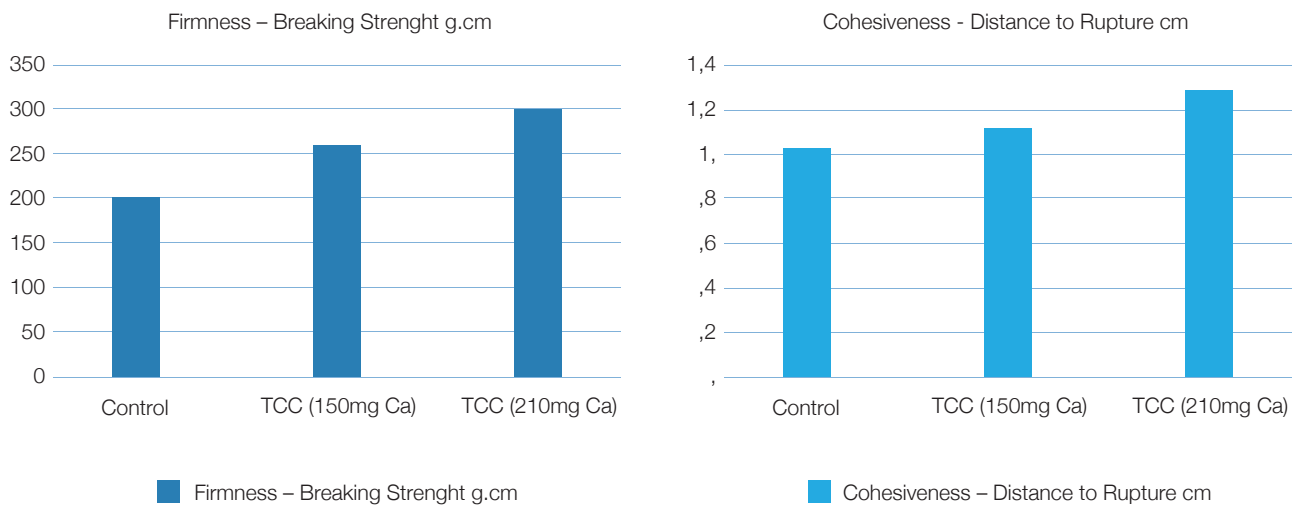
The selection of the appropriate calcium source for a specific application depends on a number of factors, including functionality, taste and bioavailability. SALT Minerals produces a range of micronized grades of tricalcium citrate that can improve dispersibility and optimise mouthfeel in food applications. In taste comparisons, calcium salts such as carbonates and phosphates tend to produce a chalky mouthfeel, whereas calcium lactate may impart bitterness and astringency at high concentrations. The organic tricalcium citrate is considered to be very neutral tasting. Furthermore any nutrient's effectiveness depends on its bioavailability. Various scientific studies have proven that organic calcium salts outperform inorganic calcium salts such as calcium carbonate and calcium phosphate in this respect. The intestinal absorption of tricalcium citrate is approximately 24% better than that of calcium carbonate, regardless of food intake. ^[4]

Besides being a nutrient, additional benefits have been observed for micronized tricalcium citrate at 150 mg and 210 mg per 100 g calcium levels in a surimi sausage formulation (table 1). These include an increase in brightness (figure 2) and textural improvement. The ingredient gave the surimi sausages a whiter appearance – a desirable attribute. The same effect is usually achieved using titanium dioxide, but the use of titanium dioxide is restricted in the United States and the ingredient is under scrutiny by the European Chemicals Agency because it is suspected of being carcinogenic when inhaled. ^[5] Trials have shown that when tricalcium citrate was added at 150 mg calcium level to surimi sausages, firmness increased by 26% and cohesiveness by 10%, as compared to controls. Fortification with tricalcium citrate at the 210 mg calcium level increased the firmness of the sausages by 46% and cohesiveness by 23%. Using tricalcium citrate does not only fortify surimi with calcium but also improves the texture and colour of the end products.

Figure 2: Surimi sausages with added micronized tricalcium citrate at 150 mg and 210 mg calcium addition levels
 Surimi sausages with added tricalcium citrate were whiter in appearance than control.



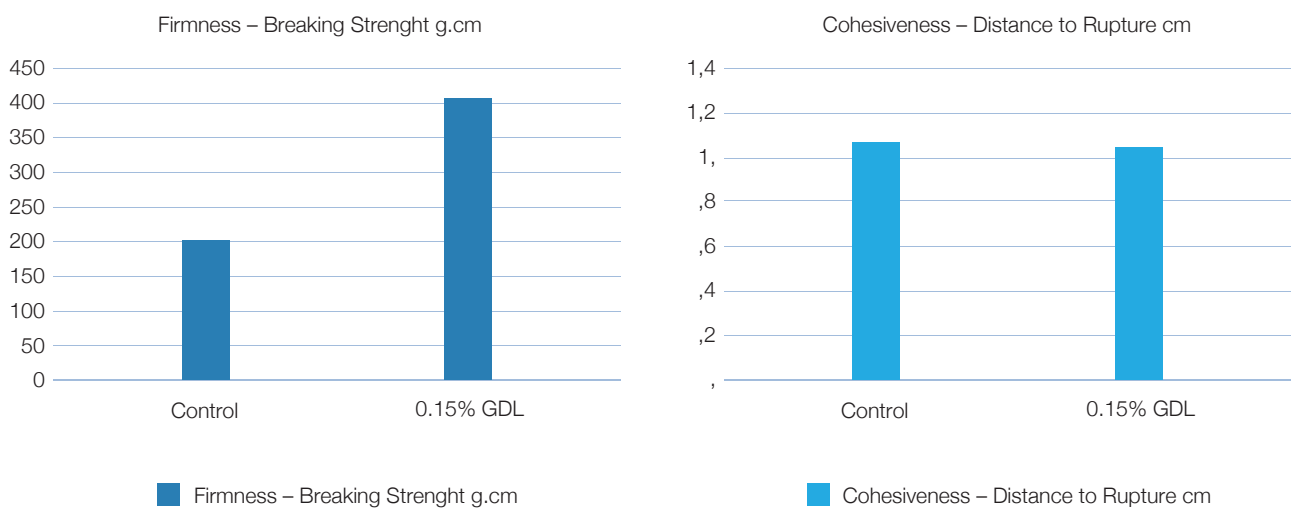
Figure 3: Firmness and cohesiveness of surimi sausage with calcium citrate
 Texture analysis was performed using a Stable Microsystems TA XT-plus Texture Analyser
 (penetration test using 5 mm spherical probe, speed 1.1 mm/s, distance 15 mm with a 5 kg load cell)



Texture improvement

Surimi is known to produce gels of very high strength and deformability. The gelation and water-holding ability of raw surimi can fluctuate depending on the different fish species used, spawning season, freshness of the fish before processing and even storage duration of frozen surimi. Because of these variations, surimi formulations often need to be adjusted before production to balance the desired texture against costs. Protein solubility can be greatly affected by pH. Solubility increases at either extremely acidic or alkaline pH, and pH shifts from 5 to 4 or from 10 to 11 can increase solubility rapidly.⁶ The use of glucono-delta-lactone (GdL) at 0.15% in surimi sausages doubles their firmness compared to control (Figure 4), while maintaining the cohesiveness. The addition of GdL lowers the pH of surimi sausages by 0.21 units, contributing to increased protein solubilisation and improved gelation.

Figure 4: Firmness and cohesiveness of surimi sausage with glucono delta-lactone (GDL).
Texture analysis was conducted using a Stable Microsystems TA XT-plus Texture Analyser (penetration test using 5 mm spherical probe, speed 1.1 mm/s, distance 15 mm with a 5 kg load cell).



GdL is a neutral cyclic ester of gluconic acid. It hydrolyses progressively to gluconic acid when added to an aqueous solution. This characteristic allows gentle acidification of food applications during processing. This is highly desirable in the preparation of surimi, as rapid acidification of the raw surimi would cause pre-gelation during comminution. The GdL preserves the soft sol texture of the surimi paste and only starts to release during the setting and cooking stage. Its mild taste sets it apart from other acidulants and it has a minimum impact on the neutral profile of surimi. Low level (0.15%) usage of GdL can increase gel strength to a staggering degree without imparting a sour taste. This makes GdL an ideal, economical ingredient to adjust texture when the quality of raw surimi fluctuates.

Conclusion

To address the desire to improve the healthiness and texture of the seafood known as surimi, SALT Minerals offers functional ingredients including tricalcium citrate for calcium fortification, sub4salt® for sodium reduction and glucono-delta-lactone for textural adjustment.

sub4salt® is able to reduce sodium content with no impact on texture, indicating good protein gelation. It can be used very simply to replace salt at a 1:1 ratio, and may reduce sodium by up to 43%.

When added at 150 mg and 210 mg calcium levels tricalcium citrate (TCC M7090), a highly bioavailable calcium salt, fortifies surimi seafood while enhancing the brightness, increasing the whiteness and improving the texture of surimi sausages. The hardness and cohesiveness of the sausages is increased by 26–46% and 10–23% respectively.

Glucono-delta-lactone offers an economical way of adjusting texture when surimi quality fluctuates. Glucono-delta-lactone can be added at the comminution stage causing no pre-gelation and effectively increasing the hardness of the surimi twofold.

References

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- [2] Functional Properties of Alaska Pollock Surimi for Applications in the Food Industry, 1985, Webb Foodlabs Inc
- [3] WHO Scientific Group on the assessment of osteoporosis at primary health care level, 2007, World Health Organisation
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About SALT Minerals

SALT Minerals GmbH is a leading provider of innovative mineral-based products and solutions, dedicated to addressing global challenges related to health and sustainability. With a diverse product portfolio, SALT Minerals serves industries ranging from food and beverage to industrial applications. Our mission is to deliver sustainable, high-quality salt solutions that enhance everyday life and industrial processes worldwide. With a vision rooted in innovation and a commitment to quality, Salt Minerals continues to elevate the role of mineral salts in shaping a healthier world.

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