EVALUATION OF PACIFIC WHITING SURIMI OR ANY SURIMI CONTAINING PROTEASES

Dr. Jae Park
OSU Surimi School

I. INTRODUCTION

Pacific whiting is harvested in the Pacific Northwest of United States and Canada. It is harvested from May through November. Pacific whiting contains a significant amount of protease that makes muscle texture soft if it is cooked slowly. Therefore the removal of those protease enzymes is critical. Even though a majority of protease is removed during washing, there is still active protease retained in the surimi.

II. EVALUATION OF PACIFIC WHITING SURIMI CONTAINING HIGH LEVELS OF PROTEASE.

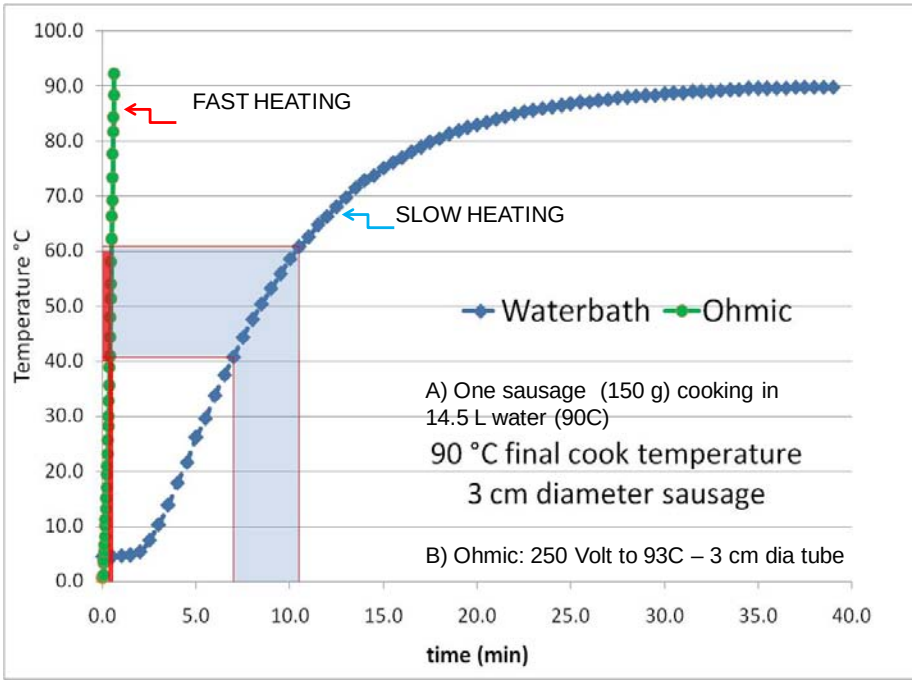

Fig. 1 – Temperature profiles of slow heating (90°C water bath: Blue) and fast heating (ohmic heat or thin sheet cooking on the crabstick line: Green). Surimi paste was cooked in a casing with 3 cm diameter (Water bath), while the surimi paste was cooked in the thin sheet (2 mm) or in 3 cm tube ohmically.

Traditionally the quality of surimi has been viewed as its gel forming ability that is determined by the standard Japanese method using punch test. In this test the surimi protein is extracted with salt and the resulting paste is cooked in a 90°C water bath for 30-40 min to develop gel formation. The resulting gel is "punched" using a rheo tex and the relative strength of the gel is measured thereby. The water bath cooking process for gel preparation is extremely slow. As indicated in Fig.1 above, time for heat penetration in surimi casing with 3 cm diameter is about 33 min to obtain the core (geometric center) temperature equivalent to 90°C. Proteolytic enzymes causing soft gel are very

active in the temperature range at 40-60°C for cold water species like Pacific whiting and pollock (50-70°C for warm water species). Referring to Fig. 1, surimi paste (in 3 cm diameter casing) is exposed to these active temperatures for 4 min (Blue shade). It is long enough for proteases to fragment the myofibrillar proteins. This 4 min exposure explains why soft or no gel is obtained with Pacific whiting surimi or surimi with high level of proteases.

Like cooking surimi paste in the water bath, traditional (suwari-induced) kamaboko cake products cooked in a steam cabinet are also subjected to very slow heating. Therefore surimi with higher protease does not give a successful result in gel evaluation as well as manufacturing kamaboko cake products. During slow cook as the heating process induces gel formation, it also stimulates the degradation of the gel being formed. The rate of degradation is directly related to the level of endogenous protease activity in the surimi.

Pacific whiting surimi will show its maximum value when it is used for the manufacture of crabstick or tempura (agemono) where the cooking process is extremely rapid. In the case of crabstick the cooking process is always less than 1 min (when cooked on drum or belts in a thin sheet). During such a short cooking time in the thin sheet endogenous proteases do not have time to extensively degrade the surimi proteins as they form a gel. As shown in Fig. 1 (A), when surimi paste is cooked on a stainless steel belt in a thin sheet (<2 mm) like crabstick manufacturing or ohmic cooking, it reaches to 90°C in less than 1 min. Interesting thing here is that time of exposure to enzyme's active temperature 40-60°C is less than 15 sec. These enzymes are also thermally killed (inactivated) when the temperature reaches 70°C.

In order to properly evaluate the suitability of surimi with high enzymatic activity, fast cook process methods are required. Methods are being developed that cook surimi test samples at rates identical to those typical in the manufacture of fast cook surimi products. They are ohmic cooking and microwave cooking. However, (even though the use of enzyme inhibitor cannot prevent the function of enzymes by 100%) enzyme inhibitors can commonly be applied to Pacific whiting or other surimi with a high level of proteases. Optimal evaluation would measure the gel strength of the surimi paste when cooked both with and without a protease inhibitor. Measurement of samples cooked with protease inhibitor predicts the performance of the product in a rapidly cook process (crabstick).

Now we reach a question "Should an enzyme inhibitor be always added in crabstick formulations to utilize Pacific whiting or other surimi with a high level of proteases?" The answer is "No".

The preceding discussion of the methods for evaluation of surimi with high levels of enzyme activity indicates that the product is best suited for manufacturing processes in which the final product is cooked quickly (i.e., crabstick, tenpura, chikuwa). The product can be used with caution in slow cook operations if a right enzyme inhibitor is properly incorporated in the formulation (i.e., fish ball, kamaboko).

III. CONCLUSION.

Surimi is graded and sold on the basis of its performance in the traditional punch test. The traditional method fails to detect functional qualities destroyed by enzymatic activity and therefore underestimates the functional value of surimi with high levels of protease activity. Additional value

can be realized to both the producer and user of the high enzyme product through careful evaluation using alternative methods and selective use of the surimi appropriately in fast cook processes.

In a practical way of evaluating Pacific whiting without containing any enzyme inhibitors, it is required to mix surimi with 1-2% plasma protein and cook surimi paste in a conventional water bath method. The result of Pacific whiting surimi with 1-2% plasma protein cooked in a water bath will be 90% similar to surimi paste cooked on a stainless steel belt as a thin sheet. Other protein inhibitors (egg white or whey protein concentrate) could replace plasma proteins, but their functionality is, relatively speaking, 50-60% of plasma proteins as shown in Figure 2 below.

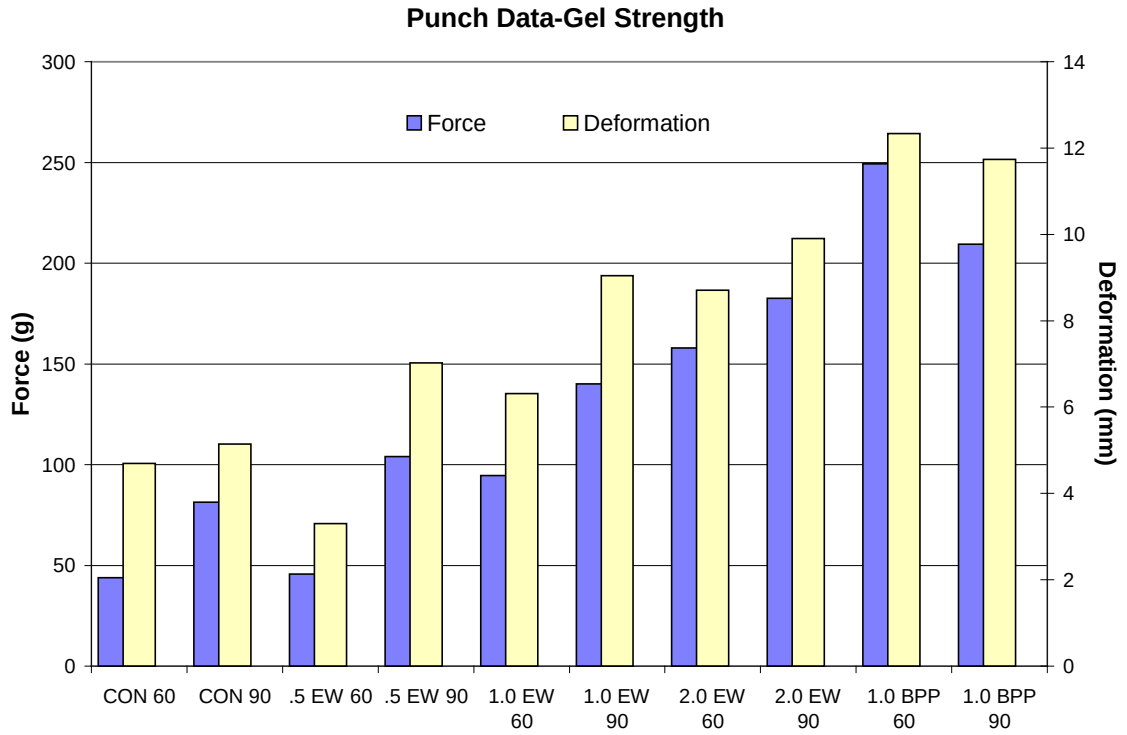

Figure 2 – Effect of egg white and beef plasma proteins on Pacific whiting surimi cooked in water bath. CON: control surimi cooked without inhibitors; EW=egg white; BPP=beef plasma protein; .5=0.5%; 1.0=1.0%; 2.0=2.0%; 60=cooked at 60C (to activate proteases) for 40 min followed by 90C for 30 min; 90= cooked at 90C for 30 min.

Pacific whiting surimi with extremely poor gel when evaluated using water bath cooking can be nicely utilized in crabstick as good as Alaska pollock. However, if it is desired to measure the real gel value that can perform on the crabstick or fried surimi seafood line, surimi has to be cooked using ohmic cooker [note: *RAPSA ohmic cooker is available for the surimi industry by Kami Steel (Seattle, WA)*.]

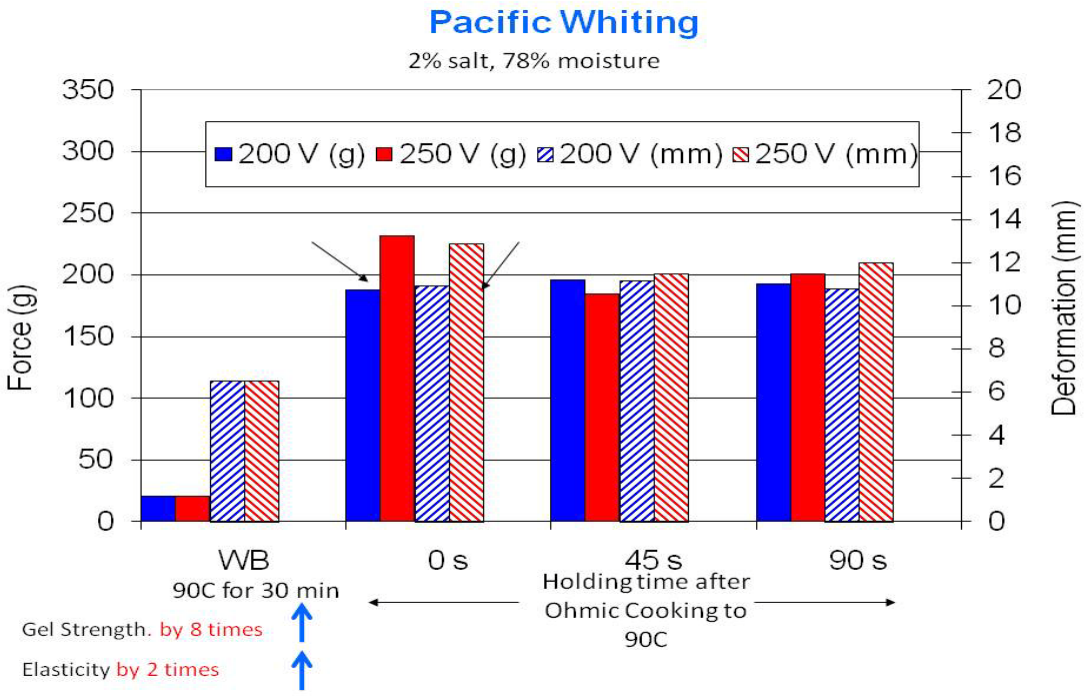

Figure 3 – PW surimi gels cooked in water bath (90C) and cooked rapidly in ohmic cooker (RAPSA).

As demonstrated in Figure 3, cooking Pacific whiting surimi or all surimi (except high grade Alaska pollock surimi) in water bath is clearly wrong. Currently these surimi are evaluated after being cooked in water bath and sold based on the value of the gel data. However these surimi can perform 2-8 times better (Figure 3) when they are used for fast cooking line (crabstick or fried surimi seafood).

For further questions, contact Prof. Jae Park (OSU Surimi School) at surimiman1@yahoo.com.