

## THE EFFECT OF *Gracilaria gigas* POWDER ADDITION IN CATFISH SAUSAGE

### *Peningkatan Kualitas Gel Sosis Ikan Lele dengan Penambahan Tepung Gracilaria gigas*

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#### Abstract

Catfish (*Clarias gariepinus*) has high content of fat and sarcoplasmic protein contents, thus it possesses low gelling capacity. Washing treatment in surimi making aimed to increase its gelling ability. The result shows that one cycle of washing gave gel strength of 1,560.23 g.cm, water holding capacity (WHC) of 81.30%, and whiteness of 59.00%. Surimi was then made into fish sausage with tapioca starch as filler and seaweed powder as gelling agent. *Gracilaria gigas* was able to increase gelling properties of catfish sausage because of their hydrocolloids contents, agar. *G. gigas* powder improved gel strength (1,831.32 g.cm), WHC (88.19%) of catfish sausage without significant changes to sensory properties of fish sausage (aroma, flavor, off-flavor, color). Catfish sausage added with *G. gigas* powder (0.50%) had comparable WHC, gel properties (gel strength, biting, and folding test) and sensory properties with commercial fish sausage marketed in Indonesia. Moreover, catfish sausages added by seaweed powder had higher dietary fiber content compare to commercial fish sausage.

Keywords: catfish, fish sausage, *Gracilaria gigas*, seaweed powder

#### Abstrak

Ikan lele (*Clarias gariepinus*) memiliki kandungan lemak dan protein sarkoplasmik yang tinggi, berakibat pada rendahnya kemampuan pembentukan gel ikan lele. Perlakuan pencucian bertujuan meningkatkan kualitas gel ikan lele. Hasil percobaan menunjukkan bahwa pencucian satu tahap memberikan kekuatan gel 1.560,23 g.cm; daya ikat air 81,30%; dan derajat keputihan 59,00%. Surimi ikan lele kemudian dibuat menjadi sosis ikan dengan tepung tapioka sebagai bahan pengisi dan tepung rumput laut *G. gigas* sebagai gelling agent. *G. gigas* dapat meningkatkan kualitas gel sosis ikan karena kandungan hidrokoloid agar yang dikandungnya. Tepung *G. gigas* meningkatkan kekuatan gel (1.831,32 g.cm), daya ikat air (88,19%) dari sosis ikan lele tanpa memberi perubahan terhadap kualitas sensori (aroma, flavor, bau asing, warna) sosis ikan. Sosis ikan lele yang diberi penambahan tepung *G. gigas* (0,50%) memiliki kualitas gel (kekuatan gel, hasil uji lipat, dan uji gigit), daya ikat air, dan kualitas sensori sebanding dengan sosis ikan komersial Indonesia. Sosis ikan lele dengan tepung rumput laut juga memiliki kandungan serat pangan yang lebih tinggi dibandingkan dengan sosis ikan komersial.

Kata kunci: *Gracilaria gigas*, ikan lele, sosis ikan, tepung rumput laut

## BACKGROUND

*Sangkuriang* catfish (*Clarias gariepinus*) is a fatty fish which also possesses high sarcoplasmic protein content. Both fat and high sarcoplasmic protein disrupt gel forming ability (Sun and Holley 2010), but many researches had reported that these undesirable components and the unpleasant odor of fatty fish can be removed by washing (Chaijan *et al.* 2010; Yada 2004). *Gracilaria gigas* own the ability of gel forming because it produces agar (Norziah *et al.* 2006).

In this research, catfish meat was utilized into surimi with washing treatment and further processed into fish sausage. Good fish sausage requires springy texture and high water holding capacity (WHC) (Santoso *et al.* 2008). The *G. gigas* powder was also applied as gelling agent in order to improve its gel properties.

## MATERIALS AND METHODS

### Materials and Equipmen

*Sangkuriang* catfish was obtained from local market at Serpong, Tangerang, Indonesia, while *G. gigas* were obtained from Lombok Island, Indonesia. Other materials needed were cold water 10°C, sodium bicarbonate, sodium chloride, hydrochloric acid, and other chemical reagents for analysis. The fish sausage was made from catfish surimi, tapioca flour, ice, corn oil, skim milk powder, salt, pepper, sugar, garlic powder, sodium tripolyphosphate (STPP), sodium glutamate, and seaweed powder.

### Research Methodology

This research was divided into two parts. Preliminary research consisted of seaweed powder making and its physico-chemical characterization; and determination of washing frequency in *Sangkuriang* catfish surimi.

Minced fish was washed with cold water for 10 minutes with water to fish ratio was 4:1. Washing frequency treatments were one, two, three, and four times. The surimi making process was done according to Santoso *et al.* (2008) with

modification with salt addition to improve the gel properties. Sodium bicarbonate (0.5%) was added in the first cycle and sodium chloride (0.3%) was added in the last cycle. The combination of both salts was added in one cycle washing. Parameters analyzed in surimi making were yield (%), gel strength (g.cm), degree of whiteness (%), WHC (%), biting and folding test. The acid insoluble ash content was determined by using the removing the acid soluble ash in hydrochloric acid 10% (Sudarmadji *et al.* 1996). Gel strength of seaweed powder was done by TA.XT Texture Analyzer (Syamsuar 2006) while analysis of sulfate content of seaweed powder was done according to the method of FMC Corp 1977 in Syamsuar 2006. Analysis of WHC was done by using centrifugation method (Gunenc 2007).

In main research seaweed powder in different concentration (0.25%, 0.50%, 0.75%, and 1%) was incorporated to catfish sausage. Fish sausages made from the chosen concentrations were compared with commercial fish sausage. The fish sausage was made from 100 g of catfish surimi, 5 g tapioca flour, 10 g of ice, 10 g of corn oil, 5 g of skim milk powder, 0.3 g of salt, 0.3 g of pepper, 0.3 g of sugar, 0.3 g of garlic powder, 0.3 g of STPP, 0.1 g of sodium glutamate, and seaweed powder.

Parameters analyzed for fish sausage were WHC(%); gel strength (g.cm); degree of whiteness (%); biting and folding test; organoleptic properties; water, ash, fat, protein, carbohydrate and fiber content (%). Proximate analyzes were done according to AOAC Method as well as dietary fiber which was analyzed by using enzymatic method (AOAC 2005). Gel strength, biting and folding test were done towards fish sausage according to the method of Amiza and Ain (2012), Cardoso *et al.* (2008) and Nippon Suisan Kaisha Ltd (1980), respectively.

All treatments in preliminary and main research were done in three replications with duplo analysis for each sample. Statistics analysis was performed by SPSS v.17.0, one-

way ANOVA ( $p < 0.05$ ) with Tukey HSD as post-hoc test.

## RESULTS AND DISCUSSION

### The Effect of Washing in Catfish Surimi

Number of washing cycles significantly affected gel strength, water holding capacity, degree of whiteness of surimi, as well as the biting and folding test results. Frequency of minced fish washing affected the quality of surimi as it can be seen in Table 1.

One and two cycles of washing gave highest surimi gel strength. Washing leaves myofibril protein (water insoluble protein) which increases elasticity and gel capacity in surimi (Chaijan *et al.* 2010). Moreover, three and four cycles of washing gave lower gel strength because more myofibril was leached out during washing. The result of gel strength was also supported by the biting and folding test done. More cycles of washing gave poorer gel properties shown by folding and biting test.

Number of washing cycle also affected water holding capacity of surimi. Myofibril protein has the ability to swell and protect water in cellular tissue and water added into it (Smith 2012). Other protein in fish, sarcoplasmic protein, contains hemeprotein which is the pigment in fish meat (Tadpetchayangkoon dan Yongsawatdigul 2009). Sarcoplasmic protein was washed out during washing thus the degree of whiteness of surimi was improved.

One cycle of washing was preferred for surimi processing treatment. Addition of

sodium bicarbonate increased pH to give optimum gelation and eased the removal of components that disturb gelation (Hiltin dan Kelleher 2000; Yada 2004).

### Seaweed powder made from *G. gigas*

The powder making of *G. gigas* gave (37.67±0.17)% yield with (47.78±0.03)% degree of whiteness. The gel strength of *G. gigas* powder (863.97±10.17) g.cm was higher compare to the gel strength of agar extracted from *G. gigas* which was 630 g.cm (Soriano 2001). The melting and gelling point of *G. gigas* powder were 66.75°C and 21.75°C, respectively.

*G. gigas* powder had (16.18±3.09)% ash content while the acid insoluble ash content was (1.80±0.71)%; moreover the sulfate content was (25.94±0.55)%. Acid insoluble ash is the insoluble chlorine salt and heavy metals salt such as silica and lead. The maximum content of acid insoluble ash in agar is 1% (Prakashan 2008). Purification process will reduce the high content of acid insoluble ash. Higher sulfate content gives lower gel strength (Soriano 2001).

### Addition of *G. gigas* powder as gelling agent in catfish sausage

Gel strength of catfish sausage was significantly increased with 0.50, 0.75, and 1.00% of *G. gigas* powder, while folding test result was improved with 0.75 and 1.00% concentration (Table 2). Agarose contained

Table 1 The effect of washing cycle towards catfish surimi

| Parameter               | Washing cycle         |                       |                       |                       |
|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                         | 1 time                | 2 times               | 3 times               | 4 times               |
| Gel strength (g.cm)     | 1,560.23 <sup>b</sup> | 1,586.30 <sup>b</sup> | 1,045.39 <sup>a</sup> | 1,004.07 <sup>a</sup> |
| Biting test             | 7.60 <sup>b</sup>     | 7.50 <sup>b</sup>     | 5.10 <sup>a</sup>     | 5.00 <sup>a</sup>     |
| Folding test            | 4.40 <sup>b</sup>     | 4.50 <sup>b</sup>     | 2.70 <sup>a</sup>     | 2.60 <sup>a</sup>     |
| Degree of whiteness (%) | 59.00 <sup>a</sup>    | 60.98 <sup>ab</sup>   | 62.04 <sup>ab</sup>   | 64.24 <sup>b</sup>    |
| WHC (%)                 | 81.30 <sup>b</sup>    | 81.85 <sup>b</sup>    | 64.64 <sup>a</sup>    | 68.36 <sup>a</sup>    |

Note: different superscripts shows significant difference ( $p < 0.05$ ) for each parameter

Biting test 1 – 10: no springiness at all – very springy

Folding test 1 – 5: gel was broken into fragments with finger pressure – no cracks on folding into quarters

Table 2 The effect of *G. gigas* powder addition in catfish sausage

| Parameter               | <i>G. gigas</i> powder concentration (%) |                        |                       |                       |                       |
|-------------------------|--|------------------------|-----------------------|-----------------------|-----------------------|
|                         | 0.00                                     | 0.25                   | 0.50                  | 0.75                  | 1.00                  |
| Gel strength (g.cm)     | 1,607.48 <sup>a</sup>                    | 1,608.31 <sup>ab</sup> | 1,841.32 <sup>b</sup> | 1,848.26 <sup>b</sup> | 2,214.50 <sup>c</sup> |
| Folding test            | 3.50 <sup>a</sup>                        | 4.30 <sup>ab</sup>     | 4.30 <sup>ab</sup>    | 4.60 <sup>b</sup>     | 4.80 <sup>b</sup>     |
| Degree of whiteness (%) | 65.30 <sup>c</sup>                       | 65.57 <sup>bc</sup>    | 64.22 <sup>ab</sup>   | 63.36 <sup>a</sup>    | 63.04 <sup>a</sup>    |
| WHC (%)                 | 85.02 <sup>a</sup>                       | 85.59 <sup>a</sup>     | 88.19 <sup>b</sup>    | 89.26 <sup>bc</sup>   | 90.20 <sup>c</sup>    |

Note: different superscripts shows significant difference ( $p < 0.05$ ) for each parameter

Folding test 1 – 5: gel was broken into fragments with finger pressure – no cracks on folding into quarters

Table 3 Scoring test result of catfish sausage added with *G. gigas* powder

| Parameter    | <i>G. gigas</i> powder concentration (%) |                          |                          |                          |                          |
|--------------|--|--------------------------|--------------------------|--------------------------|--------------------------|
|              | 0.00                                     | 0.25                     | 0.50                     | 0.75                     | 1.00                     |
| Savory aroma | 3.57 ± 0.86 <sup>a</sup>                 | 3.47 ± 0.94 <sup>a</sup> | 3.33 ± 0.88 <sup>a</sup> | 3.47 ± 1.07 <sup>a</sup> | 3.70 ± 0.84 <sup>a</sup> |
| Savory taste | 3.37 ± 0.85 <sup>a</sup>                 | 3.83 ± 0.75 <sup>a</sup> | 3.33 ± 1.24 <sup>a</sup> | 3.70 ± 0.79 <sup>a</sup> | 3.50 ± 0.94 <sup>a</sup> |
| Bitter taste | 1.83 ± 0.59 <sup>a</sup>                 | 1.73 ± 0.58 <sup>a</sup> | 1.80 ± 0.55 <sup>a</sup> | 2.03 ± 0.56 <sup>a</sup> | 1.97 ± 0.61 <sup>a</sup> |
| Color        | 3.97 ± 0.76 <sup>a</sup>                 | 3.87 ± 0.63 <sup>a</sup> | 3.70 ± 0.70 <sup>a</sup> | 3.73 ± 0.52 <sup>a</sup> | 3.80 ± 0.55 <sup>a</sup> |

Note: different superscripts shows significant difference ( $p < 0.05$ ) for each parameter

Scoring test 1 – 5: least strong – very strong; color 1 – 5: very dark – very bright

Table 4 Physical properties of different fish sausage

| Parameter               | Sausage type          |                            |                       |
|-------------------------|-----------------------|----------------------------|-----------------------|
|                         | Control               | With 0.50% <i>G. gigas</i> | Commercial            |
| Gel strength (g.cm)     | 1,607.48 <sup>a</sup> | 1,747.05 <sup>b</sup>      | 1,814.34 <sup>b</sup> |
| Folding test            | 3.80 <sup>a</sup>     | 4.50 <sup>b</sup>          | 4.40 <sup>b</sup>     |
| Degree of whiteness (%) | 65.30 <sup>c</sup>    | 64.43 <sup>b</sup>         | 39.30 <sup>a</sup>    |
| WHC (%)                 | 85.02 <sup>a</sup>    | 88.05 <sup>b</sup>         | 87.88 <sup>b</sup>    |

Note: different superscripts shows significant difference ( $p < 0.05$ ) for each parameter

Folding test 1 – 5: gel was broken into fragments with finger pressure – no cracks on folding into quarters

Table 5 Nutrition content per 100 g of fish sausage

| Content (g)             | Sausage type               |             |
|-------------------------|----------------------------|-------------|
|                         | With 0.50% <i>G. gigas</i> | Commercial  |
| Moisture                | 55.49±1.15                 | 61.91± 0.88 |
| Ash                     | 0.79± 0.17                 | 2.45± 0.11  |
| Protein                 | 11.88± 1.03                | 9.47± 0.27  |
| Fat                     | 0.85± 0.04                 | 0.51± 0.12  |
| Carbohydrate            | 30.99± 1.90                | 25.65 ±0.91 |
| Dietary fiber           | 29.00                      | 15.98       |
| Soluble dietary fiber   | 4.68                       | 1.33        |
| Insoluble dietary fiber | 24.32                      | 14.65       |

in *G. gigas* is able to increase gel strength (Laaman 2011). Similar to the effect of *E. cottonii* powder to WHC in catfish sausage (Yakhin et al. 2013), *G. gigas* powder also increased the WHC in catfish sausage. Agar binds water even through heating process and gives firm gel structure (Kim 2012).

No concentration of *G. gigas* powder added (0.25-1.00 %) gave significant changes to aroma, taste, bitterness, color of catfish sausage (Table 3).

Different concentrations of *G. gigas* powder were tested against commercial fish sausage for gel strength, folding test, degree of whiteness and WHC. Concentration of 0.50 and 0.75% were not significantly different with commercial fish sausage, yet 0.50% concentration was chosen.

#### **Comparison of Commercial Fish Sausage and Catfish Sausage with and without *G. gigas* Powder**

Further control sausage; catfish sausage with *G. gigas* 0.50%; and commercial fish sausage were compared. Table 4 showed that the gel strength, folding test result and water holding capacity of catfish sausages added with seaweed powder were improved compared to the control (catfish sausage without addition of seaweed powder), yet it was comparable with commercial fish sausage. Similar result was also observed in catfish sausage added with *E. cottonii* powder (Yakhin et al. 2013). *G. gigas* powder had significantly aided the poor gel properties owned by catfish to commercial quality which is approved by the market.

Catfish sausage with *G. gigas* seaweed powder also had comparable proximate content with commercial fish sausage (Table 5). Seaweed powder increased dietary fiber content in catfish sausages due to agarose contained; dietary fiber can be beneficial for human digestion.

#### **CONCLUSION**

One cycle of washing in catfish surimi processing had removed fat and sarcoplasmic

protein which improved gel strength, folding test result, water holding capacity, and degree of whiteness. *G. gigas* powder had improved the poor quality of catfish sausage in terms of gel strength, folding test, degree of whiteness and WHC. Seaweed powder addition did not change the flavor and color of catfish sausage and gave no bitter properties to it.

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