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"Empowerment of Marine Healthy Foods and Nutraceuticals Strengthening the Asian Region"

Department of Fish Processing Technology
Faculty of Fisheries and Marine Sciences - IPB
Bogor - INDONESIA, August 20 - 21, 2002

Edited and Compiled by
Mita Wahyuni, Slamet Budiyanto, Tati Nurhayati,
Munehiko Tanaka, and Takeshi Suzuki

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Painting source : Tanilit (1959), drying fishes

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Message from the Editorial Board

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Due to the opportunity to launch the Seminar Proceeding which involve several chapters including the keynote papers, country reports, and 56 scientific papers, we would like o express our deepest gratitude to all persons who supported the Seminar spiritually, technically, and also financially. Special thanks are also expressed to our members of Scientific Committee and our collegian from the International Advisory Committee for their kindness and peer reviewing of manuscripts. All the papers both for oral and poster presentations were collected in the first day of the Seminar, and were arranged to the respective peer reviewing by the designated 2 referees through the Scientific Committee. These reviewers were listed below. We greatly appreciated their valuable comments and suggestions to grade-up the scientific level of the Proceeding on the international base. The Editors and the Technical Editing Team were then in charge to format all the selected papers to be published in the Proceeding. The Proceeding can not be successfully completed without the great efforts and time from the Technical Editing Team. On behalf of the Executives of the Seminar, the Editors would like to express our gratitude to all colleagues mentioned below :

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STUDY ON THE PROCESS OCCURRING IN PEDA PRODUCTION

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ABSTRACT

Peda is one of the traditional fermented fish products which are very popular in Indonesia, especially Java Island. This product is able to provide a unique specific characteristic. In this study, peda was kept for three days in the first fermentation and added with salt in the second fermentation. To reveal the process occurring in the peda production, chemical, microbiological and enzymatic analyses were employed through the first and second fermentation. The results showed that during the first fermentation the salt content decreased, followed by sharp decreases in moisture content and water activity. During the second fermentation, salt and moisture contents as well as water activity were relatively constant. The growth of lipolytic, proteolytic and lactic acid bacteria decreased during the first and second fermentation. The lipolytic bacteria were the only bacterial group which was able to survive until the end of fermentation process. Counts in the gut were higher than those in the flesh. Enzymes are also involved in the peda fermentation, especially the lipolytic and proteolytic enzymes

INTRODUCTION

Peda is a popular product in Java Island, especially in West Java. This product is quite different from other fermented fish products and even from other traditional fish products such as dried salted fish, boiled salted fish, fish cracker and fish sauce.

Basic method of peda processing is a salting process with two salting steps. The first salting is normally carried out for several days and known as the first fermentation. On the other hand, the second salting takes several weeks to develop flavour and texture, and this step is called the second fermentation, or maturation phase. However, Hanafiah (1987) noted that there is no prescribed period for the processing, the length of which varies from processor to processor.

The objective of this study was to reveal the behaviour of peda during processing in both the first and the second fermentation with respect to chemical, microbiological and enzymatic changes.

MATERIALS AND METHODS

Materials

In this study, yelloweye mullet (*Aldrichetta forsteri*) was utilized as raw material for peda making. The fish had 27.4 ± 1.1 cm length, 3.2 ± 0.2 cm thickness and 182.64 ± 21.55 g weight. Proximate composition of the fish was 78.02% moisture, 15.53% protein, 4.47% fat and 1.05% ash.

Table salt with 94.84% purity level was used in this experiment. The label printed on the packaging of salt mentioned that the salt contains not more than 1% calcium silicate and free flowing agent.

Methods

1. Peda Preparation

Fish was kept at –25°C until ready for use. Fish were taken out of the freezer and thawed at room temparature before using them. During thawing, the water was run continously until the fish were separated and texture was normal.

In the first fermentation, the fish were salted using a 1:3 salt to fish ratio. Fish salt were placed in layers alternately in a plastic vat, in which thick layers of salt were added at the bottom and on the top layers to keep the saturated condition of brine, especially when the fish start releasing water. The fermentation process was carried out in an incubator at 28 – 31oC and the fermentation period was 3 days. By the end of the process, the fish were soaked in saturated brine pickle with coarse salt still present at the bottom and the top covering the fish.

After salting, excess salt was removed from fish by washing using the brine from first fermentation and draining for three hours. Draining was done to facilitate the fish for the next process, because the excess water will disturb the second fermentation. Draining was conducted by arranging the fish on trays and was carried out at ambient temperature.

In the second fermentation, the fish were put in the plain polythene bags. Salt was added amounting to as much as an one third of fish weight. This was thoroughly mixed with the fish, so that the fish were entirely covered with salt. Air inside the bags was minimized and the bags were heat sealed. The fermentation was performed in the incubator at 28-31°C and took place over 16 days.

2. Analyses

To reveal the actual process occurring in the production of peda, the fish were analyzed chemically, microbiologically and enzymatically. Analysis was performed for the flesh and the gut. The analysis for the growth patterns of bacteria during the first and second

fermentation involved total plate count, lipolytic bacteria count and proteolytic bacteria (Fardiaz, 1987) as well as lactic acid bacteria count (Sharpe and Fryer, 1966). The extracted crude enzyme from the fish was tested for lipolytic enzyme activity (Lawrence *et al*, 1967) and proteolytic enzyme activity (Erickson *et al*, 1983). The crude enzymes were extracted separately from the flesh and the gut of fish with 0.1M sodium phosphate buffer, pH 7.4 at 4°C (Zymmerman *et al*, 1988). The chemical analyses which were done were moisture content (AOAC, 1984), salt content (AOAC, 1984). a_w and pH (Irianto, 1990). Decagon CX-1 made by Decagon devices Inc, Washington, was an a_w meter used to determine a_w value.

RESULTS AND DISCUSSIONS

Microbiological Analyses

A general perception obtained from Figure 1, 2, 3 and 4 is that the gut contained much higher number of bacteria than the flesh. especially in terms of the total plate count.

Almost all observed bacteria in the flesh and the gut showed peak growth on the first day of first fermentation, except for the lipolytic bacteria which were delayed to the second day in the gut and the third day in the flesh. After these peaks. the counts of all bacteria tended to decrease, but the total plate count and the lipolytic bacteria count were relatively stable after the sixth day of second fermentation. Proteolytic bacteria and lactic acid bacteria in the flesh were undetectable by the sixth day of second fermentation, but in the gut these organisms were still detectable up to the eleventh day. At the end of the second fermentation, the total plate count and the lipolytic bacteria count appeared to be stable or increasing slightly, but their numbers were much lower than the initial numbers. The lipolytic bacteria predominated in the final stage of the fermentation process.

According to the plate count analysis, bacteria in both the flesh and the gut showed optimal growth on the first day of first fermentation, when salt and water activity were 6.45 – 7.67% (w.b.) and 0.925 – 0.927 respectively. These results were supported by measurement of the growth of proteolyitic bacteria and lactic acid bacteria. which also showed optimal growths at the first day of first fermentation. However, the optimal growth for the lipolytic bacteria occurred on the third day of first fermentation in the flesh and on the second day in the gut. Thereafter the growth of these bacteria tended to decrease, probably because of the increasing selective pressure of the environment. The pH appeared to have no effect on bacterial growth during the second fermentation, since the pH fluctuated only slightly.

Analyses of Enzyme Activity

As shown in Figure 5 and 6, the initial activities of both lipolytic and proteolytic enzymes in the gut were considerably much higher than those in the flesh.

During the first fermentation, there was an opposite trend in the lipolytic enzyme activity in the gut and the flesh. The activity in the gut tended to decrease, while the activity in the flesh was increasing. The reduction of the lipolytic enzyme activity in the gut occurred sharply at the sixth day of the second fermentation, and the prolongation of the fermentation resulted in little change after that. The lipolytic enzyme activity in the flesh peaked on the eleventh day in second fermentation, and then decreased at the end of the second fermentation. The initial activities of lipolytic enzyme in the flesh and the gut were 6.3 mm and 14mm respectively, and the activities at the end of the second fermentation were 7.0 mm in the flesh and 6.0 mm in the gut. A higher activity of the sixth day of the second fermentation and continued until the end of the second fermentation.

The activity of proteolytic enzymes during the first fermentation had a similar pattern to the activity of the lipolytic enzymes. The proteolytic enzyme activity in the flesh tended to increase slightly over the first three days, while in the gut the activity decreased sharply after the first day of the first fermentation. During the second fermentation, the proteolytic enzyme activity in both flesh and gut continued to decrease.

The analysis of enzyme activity contributed valuable information on the pedah process. Most of the lipolysis and proteolysis activities were located in the gut, especially at the beginning of the fermentation process. The enzyme activity in the gut fell rapidly during the process. This occurrence may be due to the effects of the increasing salt content in the gut, since Tressler and Lemon (1960) stated that most enzymes are destroyed or rendered inactive by concentrated salt solutions. The availability of water, measured as water activity, ahs also a strong influence on the enzyme activity (Berk, 1976). The enzyme activity declines as water activity decreases (McKay, 1989). The enzyme activity in the flesh were relatively more stable than in the gut, and were probably maintained by the enzymes released by bacteria and enzymes moving from the gut. The diffusion of visceral enzyme into tissue was noted by Owen and Mendoza (1985).

The above discussion leads to an understanding of the process occurring during the production of peda. The fermentation in peda is probably both a microbiological and an enzymatic process, in which the natural bacterial flora and the enzyme from the gut and the flesh combine to develop the flavour characteristic of peda. The bacteria probably contribute significantly only at the beginning of the fermentation, since their numbers tended to decrease, proteolytic and lactic acid bacteria disappearing completely after a period. The lipolysis process occurs microbiologically and enzymatically, but that the proteolysis is mainly the results of leakages of gut enzymes. This further suggests that probably the lipolysis process plays the main role in developing the flavour of peda. Furthermore Hanafiah (1987) informed that lipolysis was able to occur even in heavily salted fish such as the peda in this study.

These results indicate that the gut has a significant contribution in the fermentation of peda, since most of microbiological and enzymatic activities were located in the gut. This occurrence was supported by the results of the experiment conducted by Hanafiah (1987), in which the ungutted peda tended to contain more non-protein nitrogen and more free fatty acids than the gutted peda. It is suggested that leaving the gut is desirable to produce peda with a stronger flavour.

Chemical Analysis

Changes in moisture content, salt content, water activity and pH of the flesh and the gut during the first and second fermentation are shown in Figure 7, 8, 9 and 10. The pattern of chemical changes in the flesh and in the gut during a 19 day fermentation were similar.

In the first two days of the first fermentation, the moisture content of the flesh dropped more sharply than of the gut, but they were nearly the same at the end of the first fermentation. During the second fermentation, the moisture content of the gut tended to be slightly higher than that of the flesh. On the final observation, corresponding to the sixteenth day of the second fermentation, the moisture content of the flesh and the gut were approximately equal.

The pattern of salt content changes in the flesh and the gut was opposite to the pattern of moisture changes. The salt content increased particularly during the first fermentation. At the end of the first fermentation the gut had a higher salt content than the flesh and this trend continued during the second fermentation, at the end of which the gut contained 19.13% salt and the flesh 18.73% salt.

The reduction of water activity values in the gut and the flesh at the first fermentation occurred at nearly the same rate. The final water activity values were 0.757 in the gut and 0.758 in the flesh.

During the first fermentation, the pH in the flesh remained higher that that in the gut, but after three days of the second fermentation, the pH in the flesh dropped rapidly to a value of about 6.0. Variation of pH in the gut were greater that in the flesh, however, at the end of the second fermentation the gut pH had stabilized at about 0.2 units higher than in the flesh.

CONCLUSIONS

Process occurring in the peda production is microbiological and enzymatic. Leaving the gut is important in the peda processing particularly in flavour development, since the gut has a more number of bacteria and a higher enzyme activity.

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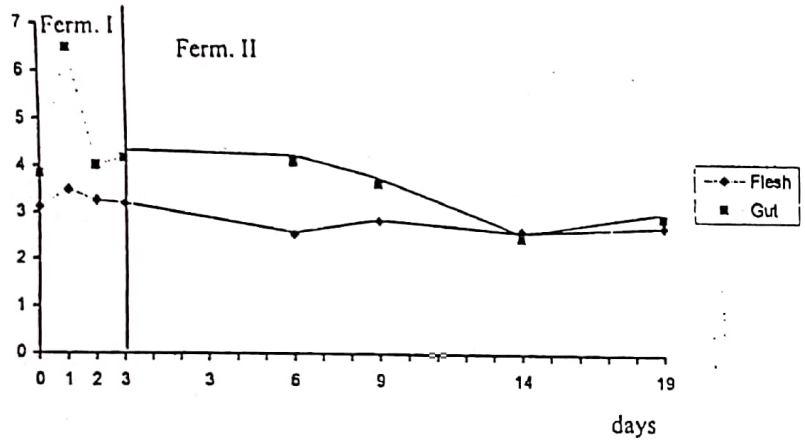

Figure 1. Total plate count of peda during fermentation (log cfu)

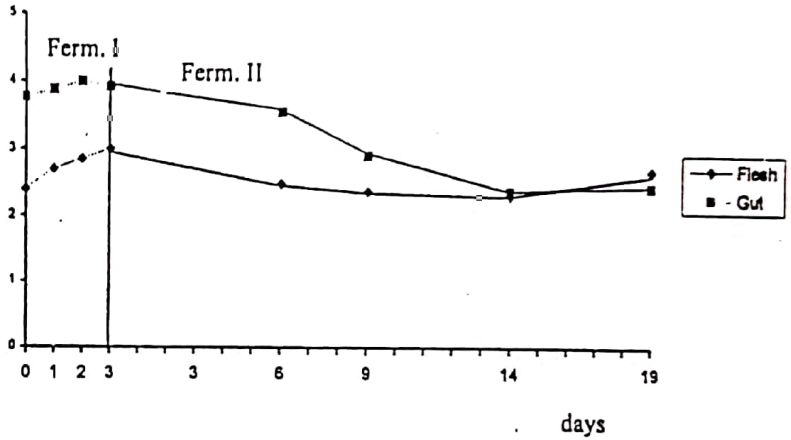

Figure 2. Lypolytic bac. count of peda during fermentation (log cfu)

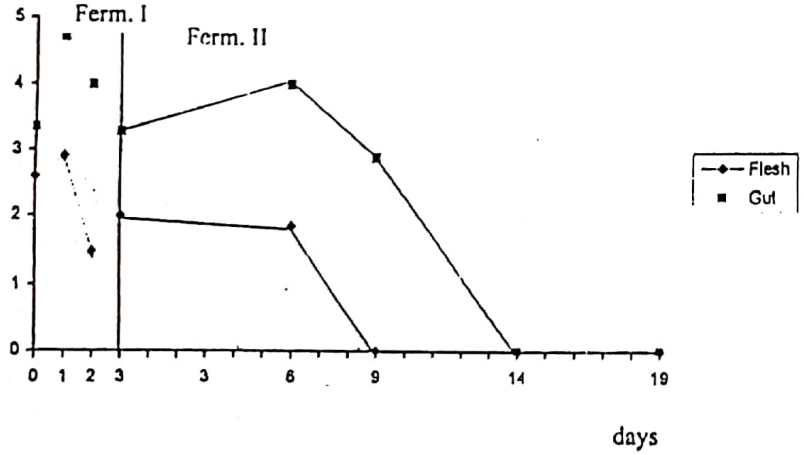

Figure 3. Proteolytic bac. count of peda during fermentation (log cfu)

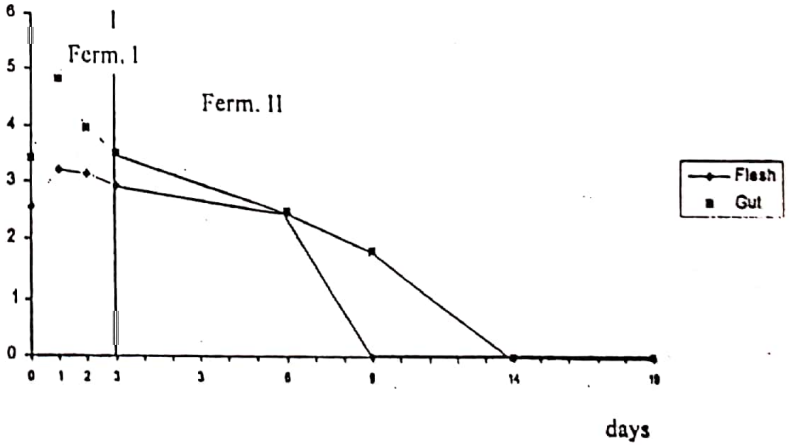

Figure 4. Lactic acid bac. count of peda during fermentation (log cfu)

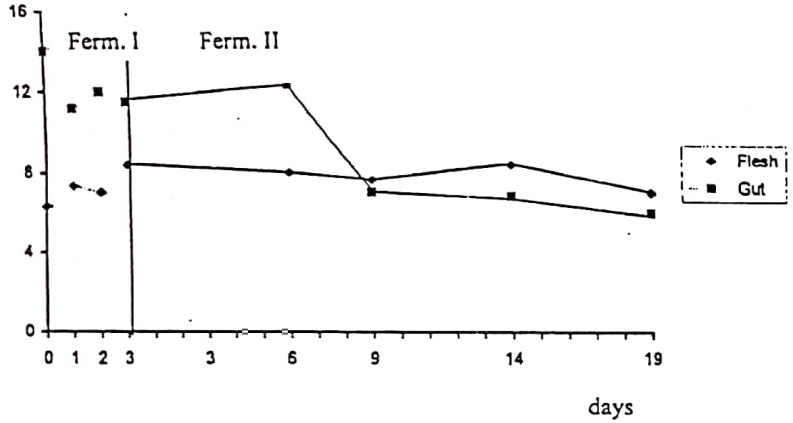

Figure 5. Lipolytic enzyme activity of peda during fermentation (mm)

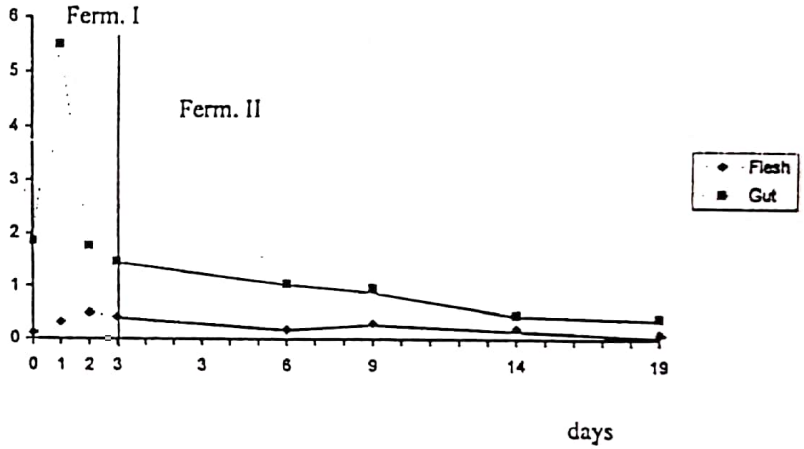

Figure 6. Proteolytic enzyme activity of peda during fermentation (abs/mg prot/30 min.)

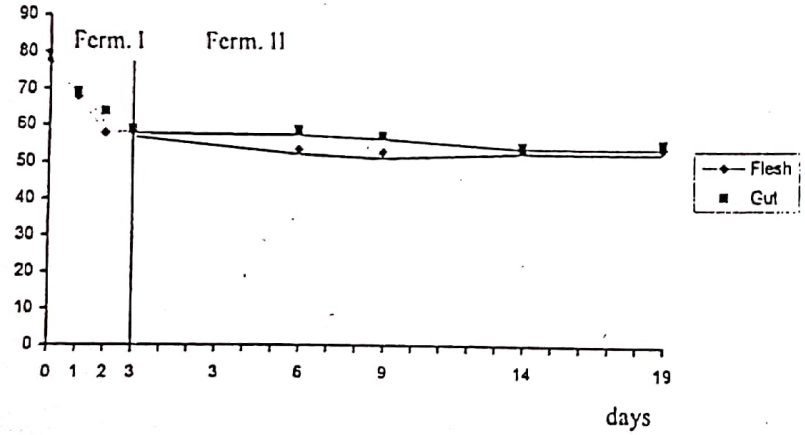

Figure 7. Moisture content of peda during fermentation (% w/w)

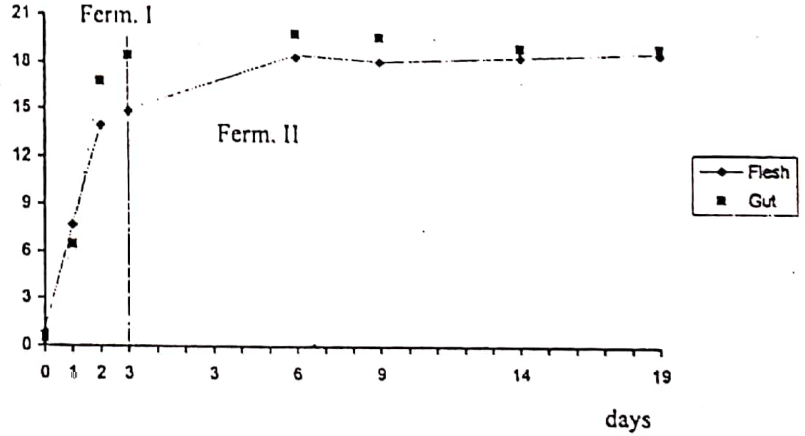

Figure 8. Salt content of peda during fermentation (% w.b)

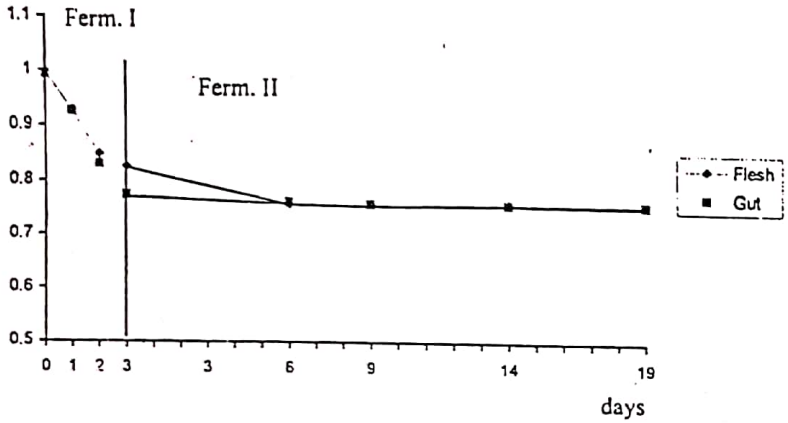

Figure 9. Water activity of peda during fermentation

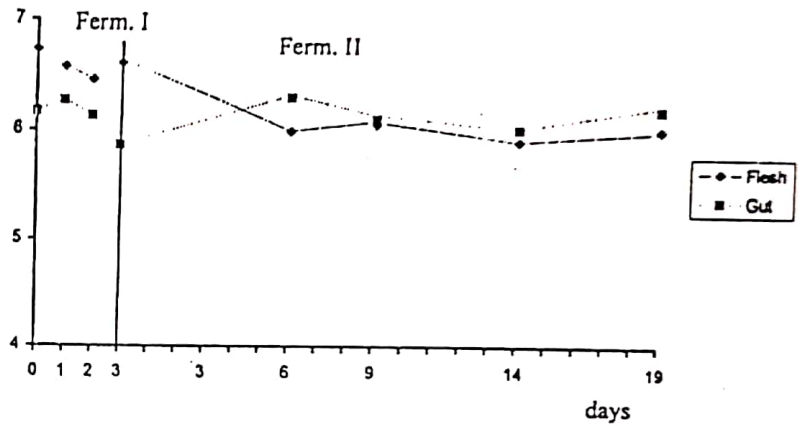

Figure 10. pH of peda during fermentation

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