BIOPROCESSED OF TIGER PRAWN (*Penaeus monodon*) WASTE PRODUCT BY DEPROTEINATION AND DEMINERALIZATION ON NUTRIENT PRODUCT

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Abstract

Research has been conducted in Laboratory of Poultry Nutrition, Non Ruminant and Feed Industry, Faculty of Animal Husbandry, Padjadjaran University, Jatinangor Sumedang. The Study was aimed to know and carried out the best nutrient products on processing of tiger prawn waste product (Penaeus monodon) through bio-process which consist of two stages: deproteination and demineralization by Bacillus licheniformis and Aspergillus niger respectively. There are two treatment used in this research, dose of inoculums and bio-process time. Nested experimental design were used on the research, A factor as dose of inoculum (Bacillus licheniformis, 3,4,5% and Aspergillus niger 2,3,4%) nested in B factor as bioprocess time (deproteinated 3,4,5 days and demineralized 2,3,4 days) with three repetitions. The results showed the best nutrient composition product (crude protein 48,54%, crude fiber 9,62%, calcium 6,94% dan fosfor 2,01 %) for 4 % Bacillus licheniformis with 4 days bioprocess and 3% Aspergillus niger with 4 days bioprocess.

Key words: bioprocess, deproteination, demineralization, tiger prawn waste, nutrient

INTRODUCTION

Tiger prawn (*Penaeus monodon*) was an Indonesian fishery commodity that many exported in frozen form. Tiger prawn has a hard skin, with large bluish green camouflage motif on the body color. Tiger prawn which rose in pond have length around 20 - 25 cm with an average weight of 140 grams.

Prawn processing waste (skin, head and tail) is between 30-40% with high enough nutrient content (38.25% crude protein, crude fiber 16.67%, 12.19% crude fat, calcium and phosphorus 5.75% 1, 59%) and gross energy (3892 kcal / kg). This resulted in the material as a protein source alternative for poultry feed. However, the existence of chitin binding proteins and minerals making it difficult digested by poultry.

Chitin is a N-Acetyl glucosamine polymer with monomers bond cellulose similar ($\beta_{(1-4)}$ glucoside), amorphous solid form and biologically degradable especially by the protease and chitinase enzyme-producing bacteria (Stephen, 1995). Chitin chemical extraction process using strong acids and bases can cause environmental damage through excessive depolymerization and corrosive. Extraction of chitin can be made through lactic acid fermentation which using *Lactobacillus spp.* then deproteinated chemically (Cira et al., 2000); or fermented by *Bacillus licheniformis* F11, and then demineralized chemically (Bisping et al., 2005). Acid fermentation can be done by *Aspergillus niger* mold which can lowering substrate alkalinity (pH).

Factors that determine the quality of tiger prawn waste bioprocess products are stages and conditions of process from each stage. Stage of the process is enzymatic protein degradation (deproteination) then followed by minerals release (demineralization) and otherwise, demineralization followed by deproteination. The other factor is conditions of process such as inoculums dose, type of microbes and bio-process time. Microorganism used in the deproteination process is *Bacillus licheniformis* and *Aspergillus niger* for demineralization process and to obtain a quality product, inoculums dose and bio-process time were optimized.

MATERIAL AND METHODS

Material for the research is tiger prawn waste with *Bacillus licheniformis* and *Aspergillus niger* as a starter.

Deproteination. Sterile prawn waste (head, skin and tail) inserted into 27 pieces stainles jars (each 250 g), then inoculated with the inoculums *Bacillus licheniformis* according to the treatment 3,4,5 % (v/w) at a temperature of 50°C (Bisping et al., 2005), then inserted into the auto-shaker bath at 120 rpm. Fermentation process carried out for 3,4,5 days. After deproteinated, it followed by demineralization.

Demineralization. Deproteinated prawn waste added tapioca flour for 15% (w/w), then put *Aspergillus niger* inoculums according to the treatment 2,3,4 % (v/w), and then incubated at a temperature of 35°C (Laskin and Hubbert, 1973) for 2,3,4 days in the fermentor.

After complete, sterilized bioprocess product at temperature of 121 °C at 1 atm pressure for 20 minutes. Bioprocess product analyzed crude protein, crude fiber, calcium, and phosphorus.

RESULTS AND DISCUSSION

Average crude protein, crude fiber, calcium and phosphorus product deproteination-demineralization (DP-M) and demineralization-deproteination (M-DP) in each treatment were analyzed and the results showed that the treatment provides a significant effect ($P < 0.05$) to the nutrient content of products. The effect of inoculums dose on each treatment can be reviewed in Table 1.

Table 1. The inoculums doses effect of product nutrition contents

Treatment	Crude Protein		Crude Fiber		Calcium		Phosphorus	
	DP-M	M-DP	DP-M	M-DP	DP-M	M-DP	DP-M	M-DP
	.....(%).....							
D1 (*B.l.* 3% + *A.n* 2%)	44,53 ^{a}	44,54 ^{a}	14,41 ^{a}	14,18 ^{a}	6,73 ^{a}	6,86 ^{a}	1,85 ^{a}	1,86 ^{a}
D2 (*B.l.* 4% + *A.n* 3%)	48,34 ^{b}	47,45 ^{b}	10,37 ^{b}	10,21 ^{b}	6,87 ^{ab}	7,00 ^{b}	1,99 ^{c}	1,96 ^{b}
D3 (*B.l.* 5% + *A.n* 4%)	49,04 ^{b}	48,03 ^{b}	9,80 ^{b}	9,44 ^{b}	6,92 ^{b}	7,17 ^{c}	1,96 ^{b}	1,97 ^{b}

Differences between the averages (means) on the same row or column will be marked by the "superscript letters" (eg, a, b, b, c, cd) (P>.05)*; B.l = B. licheniformis; A.n = A. niger; D=Dose;*

Based on Table 1 note that the nutrients in the treatment bio-process products D2 and D3 are not significantly different, but both significantly higher than D1. Another case with M-DP product calcium, D3 treatment was significantly higher than D2 and D1. Treatment D1 produces the lowest nutrient content of products; it is caused by a low dose level. D2 and D3 was not significantly different, illustrates that D2 is an effective dose of the nutrients in produce tiger prawn waste by microbiological optimized through bio-process. The numbers of microorganism that are planted are critical to quality bio-process product (Winarno, 1980; Fardiaz, 1988). Table 1 also brings the sense that the M-DP requires higher inoculums dose levels than the DP-M to produce calcium. Table 2 and 3 shown the determination of bio-process time on the inoculums doses (D2 and D3) toward the nutrient content.

Table 2. Time of bio-process on inoculums doses effect of product nutrition contents

Treatment	Crude Protein		Crude Fiber		Calcium	Phosphorus	
	DP-M	M-DP	DP-M	M-DP	DP-M	DP-M	M-DP
	.....(%).....						
D2T1 (*B.l.* 4%; 3 d + *A.n* 3%; 2 d)	45,92 ^{a}	45,34 ^{a}	12,22 ^{a}	12,17 ^{a}	6,68 ^{a}	1,93 ^{a}	1,90 ^{a}
D2T2 (*B.l.* 4%; 4 d + *A.n* 3%, 3 d)	49,54 ^{b}	48,13 ^{b}	9,62 ^{b}	9,29 ^{b}	6,94 ^{b}	2,01 ^{b}	1,98 ^{b}
D2T3 (*B.l.* 4%; 5 d + *A.n* 3%; 4 d)	49,57 ^{b}	48,88 ^{b}	9,26 ^{b}	9,18 ^{b}	6,99 ^{b}	2,03 ^{b}	2,00 ^{b}

Differences between the averages (means) on the same row or column will be marked by the "superscript letters" (eg, a, b, b, c, cd) (P>.05)*; B.l = B. licheniformis; A.n = A. niger; D=Dose; T= Time;*

Tabel 3. Time of bio-process on inoculums doses effect of product calcium contents

Treatment	Calcium Product Average	Significance (0.05)
	.....(%).....	
D3T1 (*A.n.* 4%, 2 days + *B. l.* 5%, 3 days)	6,98	a
D3T2 (*A.n.* 4%, 3 days + *B. l.* 5%, 4 days)	7,25	b
D3T3 (*A.n.* 4%, 4 days + *B. l.* 5%, 5 days)	7,27	b

Differences between the averages (means) on the same row or column will be marked by the "superscript letters" (eg, a, b, b, c, cd) (P>.05)*; B.l = B. licheniformis; A.n = A. niger; D=Dose; T= Time;*

D2T1 treatment produced the lowest nutrient content products; it because of shorter bio-process time, so microbial population has not reached its peak and affects enzyme production to be not optimal. Nutrient products on D2T3 treatment were not significantly different with D2T2. This is as a consequence of long bio-process that resulting nutrients in D2T3 substrate been reduced, so the fermentation process were not effective.

Inoculums dose level and bio-processes time related to the amount of potential microbial population of at least faster growth in the production of microbial enzymes to break down the substrate, which in turn affect the final product. The higher dose of inoculums and bio-processes time are used, the more the microbial population and the same and also to the altered substrate components. Nevertheless, the existences of too much microorganism were made too fast sporulation, so microorganism does not grow optimally (Battley and Edwin, 1987; Tjahyadi, 1990). Changes in substrate chemical composition caused by microbial activity *(Bacillus licheniformis* and *Aspergillus niger*) that transform complex molecules into simpler ones (Skinner and Carr, 1981; Hall and De Silva, 1992; Ratledge, 1994; Balia, 1996).

The fact that in order to get the best nutrients have been found in D2T2 treatment, either in the process of DP-M (*Bacillus licheniformis* 4% for 4 days followed by *Aspergillus niger* 3% for 3 days), and the M-DP (*Aspergillus niger* 3 % for 3 days followed by *Bacillus licheniformis* 4% for 4 days).

CONCLUSIONS

The pattern of deproteination-demineralization process on tiger prawn waste fermentation (bio-process) using *Bacillus licheniformis* dose 4% for 4 days followed by doses of *Aspergillus niger* 3% for 3 days were effective toward the achievement of crude protein content (49.54%), calcium (6, 94%), and phosphorus (2.01%) high, and followed by low crude fiber content (9.62%).

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