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Efficacy of fibrolytic enzymes on digestibility of some local raw materials for aquafeed

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Introduction

Local raw materials such as maize, cassava, sorghum, broken rice, banana, cowpeas, groundnut, and brewery wastes are considered as potential materials for fish feed. These have been examined on their minimum protein and energy contributions since this is the most expensive part of the fish feed. Alternative sources to animal proteins and energy are also examined. Plant protein from groundnut, rape seed meal, cotton seed meal and others compare favorably with bloodmeal mixture and thus can be used to replace the more expensive animal proteins. Energy material in fish feed from cassava, rice bran, and others including agro-industrial waste compare to wheat grain and corn can be used for energy source. Pellet feed can be produced on a small scale or commercial basis from the locally available raw materials and the fish farmer is advised to seek assistance from qualified fisheries personnel.

In Thailand, cassava (*Manihot esculenta* Crantz) is considered one of the most important economic crops with annual production of around 25 million tons. These cassava occupies the largest cassava starch planted area in Thailand [1]. Currently, more than 90% of the total cassava starch factories in Thailand have installed and utilized anaerobic wastewater treatment systems to produce biogas which can cover 100% of the factory's thermal energy requirements. The solid waste after starch extraction, i.e. cassava pulp, is also used for biogas production and animal feed in a form of dry cassava/tapioca fibre. The development of cassava pulp to other value-added products is showing continual progress. The analyses of the chemical composition of cassava peels indicate the following chemical composition: dry matter, 86.5-94.5%; organic matter, 91.1%; nitrogen 1.0 %; neutral detergent fibre 57.4%; acid detergent fibre 28.4%; hemicellulose 29.0%; cellulose 20.8%; acid insoluble ash 2.8%; acid detergent lignin 5.0%; calcium 0.7%; phosphorus 0.10%; magnesium 0.15%; sulphur 0.08%; copper 11ppm; zinc 20 ppm; and manganese 86 ppm [2]. Cassava peels have been evaluated as a feedstuff for animals [3].

The aim of the study was to evaluate the efficacy of fibrolytic enzymes on digestibility of some local raw materials for aquafeed**.**

Materials and methods

Local raw materials
Local raw materials including Soybean meal (SBM), rice bran (RB), cassava pulp (CP) and cassava skin (CS) were study by milled to flour in the size of 63-425 micrometre by hammer mill and dried overnight at 55°C in an hot- air oven [4].

Fibrolytic Enzymes
Three fibrolytic enzymes consist of xylanase, cellulase, mannanase were used in the study by designed in five treatments.

Experimental designed
The experiment was conducted by using 5×4 factorial in completely randomize design with five fibrolytic enzymes treatments for digested four local raw materials. The fibrolytic enzymes were xylanase at 24,000 U/Kg)T1(, cellulase at 10 U/Kg)T2(, mannanase at 750 U/Kg)T3(, combination of cellulase and mannanase (T4) at the same proportion (0.5:0.5 of T2 and T3(and a combination of cellulase and mannanase (T5) at the same proportion)1.0:1.0 of T2 and T3(for digesting these four materials, SBM, RB, CP and CS. Aquafeed materials were incubated with phosphate buffer at the optimum pH for each enzyme from each treatment. The reducing sugar yield from each enzyme activity was determined by 3,5-dinitrosalicylic acid which represented the amount

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of mg of reducing sugars per 1 g of local raw materials [5]. All determinations were done three times to estimate mean values and standard deviations.

Results

Results of *in vitro* digestibility showed that cellulases)T2(exhibited the highest enzyme efficacy to digest fiber from these four materials follow by combination of cellulase and mannanase (T5), mananase)T3(, combination of cellulase and mannanase (T4) and xylanase)T1(, respectively. For the Aquafeed materials in this study, the results showed that fiber from rice bran in term of cellulose was easy to digest than, soybean meal, cassava skin, and cassava pulp, respectively ($p<0.05$). Mannan in rice bran was easy to digest than soybean meal, cassava skin and cassava pulp, respectively ($p<0.05$). Xylan in rice bran also was easy to digest than soybean meal, cassava skin and cassava pulp, respectively ($p<0.05$). The sum of sugars (glucose, xylose, maltose and mannose) form rice bran was highly significantly different ($p<0.05$) than soybean meal, cassava skin, and cassava pulp (Table 1). Sum of sugars form rice bran by T1, T2, T3, T4 and T5 enzyme were 0.650 ± 0.294, 1.182 ± 0.445, 1.035 ± 0.263, 0.926 ± 0.368 and 1.879 ± 1.125 mg/g, respectively. Sum of sugars from soybean meal by T1, T2, T3, T4 and T5 enzyme activity were 0.222 ± 0.057, 0.248 ± 0.078, 0.232 ± 0.054, 0.208 ± 0.068 and 0.280 ± 0.014 mg/g, respectively. Sum of sugars from cassava pulp by T1, T2, T3, T4 and T5 enzyme activity were 0.076 ± 0.034, 0.075 ± 0.017, 0.073 ± 0.026, 0.098 ± 0.062 and 0.092 ± 0.062 mg/g, respectively. Sum of sugars from cassava skin by T1, T2, T3, T4 and T5 enzyme activity were 0.053 ± 0.008, 0.235 ± 0.109, 0.114 ± 0.027, 0.063 ± 0.015 and 0.075 ± 0.038 mg/g, respectively (Fig. 1).

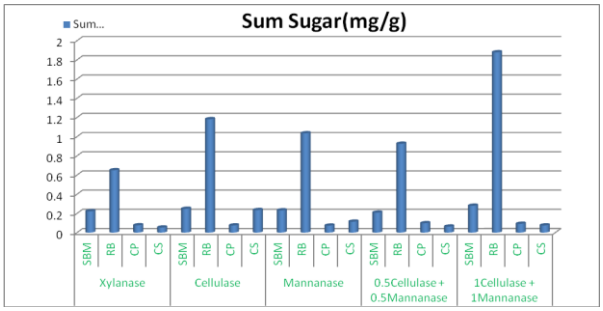

Fig. 1. The sum of sugars (glucose, xylose, maltose and mannose) from rice bran was significantly higher ($p<0.05$) than the other materials (A) Sum of sugars (mg/g); (B) Five fibrolytic enzymes consist of xylanase at)T1(, cellulase)T2(, mannanase)T3(, combination of cellulase and mannanase (T4) at the same proportion (0.5:0.5 of T2 and T3(and a combination of cellulase and mannanase (T5) at the same proportion)1.0:1.0 of T2 and T3(.

Table 1. The sum of sugars (glucose + xylose,+ maltose + mannose) yield was represented the amount of mg of reducing sugars per 1 g of some local raw materials

Treatment	Raw material	Sum sugar (mg/g)
T1=Xylanase	1=SBM	0.222±0.057[b]
	2=RB	0.650±0.294[a]
	3=CP	0.076±0.034[b]
	4=CS	0.053±0.008[b]
T2=Cellulase	1=SBM	0.248±0.078[b]
	2=RB	1.182±0.445[a]
	3=CP	0.075±0.017[b]
	4=CS	0.235±0.109[b]
T3=Mannanase	1=SBM	0.232±0.054[b]
	2=RB	1.035±0.263[a]
	3=CP	0.073±0.026[b]
	4=CS	0.114±0.027[b]
T4=0.5Cellulase + 0.5Mannanase	1=SBM	0.208±0.068[b]
	2=RB	0.926±0.368[a]
	3=CP	0.098±0.062[b]
	4=CS	0.063±0.015[b]
T5=1Cellulase + 1Mannanase	1=SBM	0.280±0.014[b]
	2=RB	1.879±1.125[a]
	3=CP	0.092±0.062[b]
	4=CS	0.075±0.038[b]
P-Value 0.355	0	0.599

[a,b] Significantly different ($p<0.05$).

Discussion

The fiber digestibility by fibrolytic enzymes on rice bran was significantly higher than the other local raw materials for aquafeed. The combination of cellulase and mannanase (T5) producing the highest reducing sugar production.

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