MAXIMIZING UTILIZATION OF LOW-VALUE FISH FOR A BETTER FUTURE - USING BLACK TILAPIA AS THE MODEL

by

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ABSTRACT

The estimation for the cost of production of breaded tilapia and hydrolysate from the head were carried out to determine the feasibility of commercialising the products. This was in view of maximizing the utilization of the resources. It was found that the costs of producing breaded tilapia fillets was Rm 13.72 and that of hydrolysate was Rm 1.81[1]. Based on the comparison of prices of competing products in the same category of products, it was concluded that the production of both the commodities were very viable.

INTRODUCTION

Fish harvested from marine resources are not as controllable as fish from aquaculture activities. Black tilapia is one of the many fishes which are produced from these activities. Its production volume is constrained by its pattern of consumption and utilization i.e. mainly in fresh or unprocessed form. Its marketability in some Asia-Pacific countries such as Malaysia is also limited by the less popular characteristic muddy odour and flavour. This characteristic is mainly due to the presence of geosomin and 2-methylisoborneol (Yurkowski and Tabachek,1974, 1980; Kuusi and Suihko, 1983). Off-flavour in fish is a world-wide problem in cultured fish (Lovell et al., 1978). One of the possible avenues for increasing its market value and share is by developing new value-added products and by utilizing the by-products of the industry. Studies carried out at the faculty has proven that the battered and breaded tilapia fillets are marketable (Jamilah and Wong, 1996; Jamilah and Siti Aini, 1997); however, the market price as well as the commercialisation of the product has not been tested. Presently, there are many breaded fish products sold in the market - filleted and surimi based, in particular. These products are non-tilapia, non-freshwater/brackishwater fish based. They are potential and direct competitors to breaded tilapia. Thus, the pricing of breaded tilapia must take into account the competitors' pricing i.e. the price of breaded tilapia should be at par or lower than that of the competitors' prices. The costing of hydrolysate which is the by-product of breaded tilapia will also be considered. At the time of this study, no production of hydrolysate from local companies could be registered. Therefore, the objective of this paper is to estimate the cost of production of breaded tilapia and hydrolysate to determine the feasibility of commercialising these products.

[1] At the time of writing, the exchange rate was approx. Rm 4.1 to US$ 1.00

METHODOLOGY

Live black tilapia (*Oreochromis mossambicus*) was purchased from a fish farmer nearby the university. They were brought alive to the processing laboratory and killed immediately with a sudden blow on the head. Filleting was then done manually and the fillet was first washed in ice-slush and rinsed in cold water to remove blood and slime. Weight of fillets and heads obtained were recorded to calculate the yield. They were then pooled and placed in the refrigerator prior to the battering-breading and hydrolysis process. The battering and breading of the fillets for the production of breaded product was according to Jamilah and Siti Aini (1997). The fish heads were washed, homogenised and hydrolysed according to Yanez et al. (1976) and Mackie (1982). The yield of the hydrolysate was determined by measuring the volume of hydrolysate obtained after centrifugation versus the original volume.

Each processing step was timed to gather information on the time required to complete the job. Information on cost of equipment was sourced from recent actual purchasing of the equipment or was sourced from the local suppliers. Information on insurance and others were sourced from agents. Detailed information on oil and breading material pick-up were obtained from Jamilah and Wong (1996). The pricing of competitive products as surveyed in several chain supermarkets and hypermarkets within 50 km radius of the university campus. The costing for the production of breaded tilapia and hydrolysate was based on the capacity identified for medium scale industry (capital investment of Rm100K to 200K).

RESULTS AND DISCUSSION

Like all other manufacturing activities, the manufacturing cost must be known to measure inventory values (and so the cost of goods sold) and profitability (revenues minus expenses, which include cost of goods sold).

Breaded tilapia:

Three cost elements in the production of breaded tilapia are identified. They are the direct material, direct labour and factory overheads. The direct materials (Table 1) are black tilapia, breading material and frying oil. The average yield of black tilapia fillet is 38%, the breading material and frying oil pick-up are 3 and 2% respectively. Cumulatively, the yield for every kg of black tilapia is 43% or 430 g of breaded tilapia.

Based on the statistics derived in Table 1, the amount of black tilapia required to produce 1 kg of breaded fillet can be computed. Table 2 shows that for every 2.63 kg of black tilapia, 1 kg of fillet will be produced. At the time of study, the average cost of black tilapia was Rm3.20 per kg. Thus, the total main material cost to produce 1 kg of breaded fillet is Rm8.42. However, this cost can be lower since the ex-farm price is at Rm2.40 - 2.80 when purchasing is done at bigger quantities. As cooking oil and breading material are considered as part of the direct material costs, they are then added together to determine the total direct material cost. Therefore, the total estimated direct material costs to produce 1 kg of breaded tilapia is approximately Rm8.70.

Table 1. Yield calculation for breaded tilapia and hydrolysate.

Yield from 1 kg of live tilapia:

1 Kg of live tillapia can produce	380 gms of fillet	38%
Breading pick-up	30 gms	3%
Frying oil pick-up	20 gms	2%
Yield	430 gms	43%

Based on yield statistics above raw materials used can be compute follows:

Fillet:

1 Kilogram of live tilapia X 38 % = **380 gms**

Breading material required to produced 1 Kg of fillet:

1,000 gms X 30 gms = **79 gms**
380 gms

Cooking oil required to produced for every 1 Kg of fillet:

1,000 gms X 20 gms = **53 gms**
380 gms

HYDROLYSATE:

Raw material is derived from live tilapia fish head as follows:
1 kg of live tilapia is equivalent to 180 gms (18%) of fish head.

Table 2. Estimated production cost of 1 kg of Breaded Tilapia.

Manufacturing cost elements	Estimated Quantity	Estimated x cost per kg	Total
Raw materials:			
	Kg	Rm	Rm
Live Tilapia	2.63	3.2	8.416
Breading	0.079	2	0.158
Cooking oil	0.053	2.4	0.1272
			8.7
Direct labour:			
	Estimated hours	Estimated cost per hour	
Labour hours used	0.67	5	3.35
Manufacturing overhead:			
Estimated overhead			1.65
Estimated cost of 1 kg of breaded tilapia			13.7

It requires 0.67 hr of direct labour to produce 1 kg of breaded tilapia. Currently, the average market rate for labour is Rm5.00 per hr. Hence, the average cost of direct labour to produce 1 kg of breaded tilapia is Rm3.35 (Table 2).

Finally, the firm has to incur the factory overhead which consists of costs that are indirectly associated with the manufacture of the finished product. They are manufacturing costs that cannot be identified as either direct material or direct labour. Table 3 details the manufacturing costs that should be

captured under the heading of factory overheads - utilities, packaging material, supervision, indirect labour, factory insurance, and depreciation of fixed assets (i.e. depreciation of factory buildings and machinery). Table 5 shows a detail listing of fixed assets required to produce breaded tilapia. Based on a one yr projected production of 36,400 kg of Rm1.67.

Table 3. Estimated production cost of 1 L of Hydrolysate.

Manufacturing cost elements	Estimated quantity Kg	X	Estimated cost per Kg Rm	Total Rm
Raw material:				
Tilapia head	1		0	0
Direct labour:				
Labour hours used	0		0	0
Manufacturing overhead:				
Expected overhead per litre				1.81
Estimated cost of 1 L of hydrolysate				1.81

To sum up, the estimated total manufacturing cost of 1 kg of breaded tilapia is approximately Rm13.72 (Rm8.70 + 3.35 + 1.67). The cost derived is only the manufacturing cost which exclude the administrative and selling expenses. To make profit, the firm's projected/planned selling price should be greater than the projected manufacturing costs, administrative and selling expenses. This estimated cost seems to be competitive since the present closest competing product is a breaded marine product which is selling at Rm4.30 - Rm4.90 per 250 g pack. This approximates to Rm17.20 per kg based on the average selling product price of Rm4.60 per 250 g. However, surimi-based products are cheaper, i.e. selling at an average price of Rm4.90 per 500 g.

Hydrolysate

The costing of the hydrolysate which is produced from the fish heads (the industrial waste) can contribute positively to the firm's profit. This would mean that the raw material cost for the production of the hydrolysate is nil given the firm's main objective is to produce breaded tilapia and the production of hydrolysate is secondary i.e. it will be produced when the firm decides to produce breaded tilapia. On the other hand, if in the beginning it was decided that the firm's main objective is to produce both products than it would be fair to include the fish head as a direct cost in the production of hydrolysate. Thus, it is logical to assume that there is no direct material cost required to produce the hydrolysate (Table 3).

It requires 95,732 kg of live tilapia to produce the projected 36,400 kg of breaded tilapia. The amount of fish heads that can be collected is 17,232 kg. The estimate is based on the average yield weight of fish heads which is 18% (Table 1). The starting volume of hydrolysis was 34,464 L due to the adjustment made to obtain approximately 8% protein content in the starting material. The yield of the hydrolysate is 80% after the removal of the sediments which is equivalent to 27,571 L (Table 4).

Table 4. Computation for factory overhead, administration and selling expenses.

	Factory Overhead			Admin. & Selling Expense
	Total	**Breaded Tilapia**	**Hydro-lysate**	
Activity Index		Kilogram	Litres	
Amount of production for one year (Note 1)		36,400	27,571	
Costs	**Rm**	**Rm**	**Rm**	**Rm**
Variable costs:				
Utilities (allotted based on 8:2)	17,000	13,600	3,400	
Packaging-plastic bags (Rm0.3x91,000 pieces)	27,300			27,300
Packaging – aluminum laminate of 1 kg (Rm1 x 17,232 pieces)	17,232			17,232
	61,532	13,600	3,400	44,532
Variable cost per kilogram		0.374		
Variable cost per litre			0.123	
Fixed costs:				
Supervision (1 x Rm1,400 per month x 12) allotted based on 8:2	16,800	16,800	4,800	2,400
Indirect labour (2 x Rm 800 x 12)	19,200		19,200	
Insurance (allotted based on floor space) Note 2)	7,180	6,424	460	294
Depreciation (see Table 3)	48,460	23,780	22,200	2,480
Clerk (Rm 1,000 x 12 months)				12,000
Utilities				1,000
	91,640	47,004	46,660	18,174
Absorption rate for fixed cost based on per kilogram of raw material used:		95,732	17,232	
		Rm0.491	Rm2.70	
Estimated predetermined manufacturing overhead rate to produce 1 unit of product:				
Fixed overhead	0.374		0.123	
Variable overhead	1.291 (Note 3)		1.688 (Note 4)	
	1.665		1.81	

Another interesting feature in the production of the hydrolysate is that it requires a negligible effort from labour. This is indirect labour and not a direct labour. Efforts from labour is only used for the transfering of fish heads into the hydrolysis vessel, monitoring of the hydrolysis and dispensing of hydrolysate into the packaging material which requires minimal effort. Thus, like the raw material which carries no cost to the firm, there is also no direct labour cost (Table 3) to produce the hydrolysate.

The only manufacturing cost required in the production of hydrolysate would be the factory overhead. These would include packaging material, supervising, indirect labour, depreciation of machinery - hydrolysis vessel, centrifuge, spray dryer, factory building (Table 5), and insurance (Table 4). To sum up, the cost of producing 1 L of hydrolysate is approximately Rm1.81. Imported fish and cuttlefish hydrolysates from China and Thailand are priced at an average price of Rm3.90 per L.

Table 5 Types, Number of Units and Cost of fixed assets required in the production of breaded tilapia and hydrolysate and the estimated depreciation cost per year.

	Depreciation					Amount of depreciation allotted per year		
	Number of unit	Cost (Rm) per unit	Total (Rm)	Rate applied	Depre-ciation per year	BREADED TILAPIA	HYDRO-LYSATE	OFFICE
Breading machine	1	50,000	50,000	0.1	5,000	5,000		
20 litre batch fryer	3	15,000	45,000	0.1	4,500	4,500		
20 kg washing machine	1	10,000	10,000	0.1	1,000	1,000		
Blast freezer (20 kg)	1	50,000	50,000	0.1	5,000	5,000		
Walk-in chiller (10 x 10 sq. ft)	1	8,000	8,000	0.1	800	800		
Ice making machine	1	9,600	9,600	0.1	960	960		
Walk-in freezer (270 sq. ft (15'x18'x10')	1	30,000	30,000	0.1	3,000	3,000		
Hydrolysis vessel	1	80,000	80,000	0.1	8,000		8,000	
Centrifuge	1	50,000	50,0000	0.1	5,000		5,000	
Spray dryer (50 kg input)	1	80,000	80,000	0.1	8,000		8,000	
3 units of 3HP air-cond. at Rm 5,000 per unit	1	15,000	15,000	0.1	1,500	1,000		500
Building (3,500 sq. ft @ Rm60 per sq. ft) See Note 1 (allotted based on the following ratio-21:10:4)	1	210,000	210,000	0.02	4,200	2,520	1,200	480
Land (10,000 sq ft x Rm 20 per sq ft)	1	200,000	200,000	0	0	0	0	0
Personal computer	1	5,000	5,000	0.2	1,000			1,000
Office furniture (table, chairs and filing cabinet)	1, 3 and 1		5,000	0.1	500	0	0	5,000
TOTAL			847,600		48,460	23,780	22,200	2,480

Note 1: Building space will be utilized as follows:

Breaded Tilapia	3131 sq ft	(89.5%)
Hydrolysate	225 sq ft	(6.4%)
Administrative	144 sq ft	(4.1%)
Total	3500 sq ft	(100.0

SUMMARY

The estimated cost of manufacturing breaded tilapia and hydrolysate from tilapia heads are Rm13.72 and Rm1.81 respectively. Based on the prices of similar groups of products for breaded tilapia and hydrolysate selling price, it is apparently viable to commercialized and fully utilized black tilapia. Although the production of breaded tilapia alone is economical, the production of hydrolysate from the waste of the industry is certainly more profitable.

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