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Development and Acceptability of Burgers made from *Selaroides leptolepis* and *Aristichthys nobilis*

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Abstract

Fishburgers were developed from *Selaroides leptolepis* and *Aristichthys nobilis*. In-house sensory evaluation showed that the formulation with a ratio of 40:60 *S. leptolepis* to *A. nobilis* was most acceptable. A market trial of the product showed good acceptability in terms of taste, texture, colour and juiciness. 52.8% of the respondents were willing to pur-chase the fishburgers at a price range of US$2.24 to US$2.60.

Introduction

Of the many species of fish caught in the waters off the coast of Malaysia, a significant proportion constitutes commercially unimportant and hence underutilized species (29% of the total marine fish catch in 1994) (Anon. 1994). Currently, most of the underutilized species are processed by traditional methods such as curing, which do not involve high costs. However, such products do not enjoy high-market value (Yu and Siah 1996). The supply of fish for human consumption can be greatly enhanced by reducing post-harvest losses and better utilization of small pelagics and shrimp by-catch (Morrissey 1988). Value-added products from these species can have good profit potential with demand from major markets such as Japan, USA, and the European Community (Lambert, 1990). Market opportunities are available for developing countries in value-added fish products (Young 1982; FAO 1987). Development of minced fish and mince-based products provide dual opportunities for the utilization of low-value fish for human consumption as well as diversification of the fish processing industry into international trade in value-added products. Underutilized fish have been processed into useful consumer products such as cutlets from threadfin bream (Joseph *et al.* 1984); breaded patties from cat fish (Burgin *et al.* 1985); and fish balls from mixed by-catch (Jantawat and Yamprayoon 1990).

Selaroides leptolepis accounted for 3% of the total marine fish catch of 1,065,585 mt in Malaysia in 1994 (Anon. 1994). It is a relatively small pelagic fish and a substantial quantity is salted, or salted and dried. *Aristichthys nobilis* or big head carp is a common species cultured in disused mining pools in

Malaysia. Freshwater fishes are less acceptable to consumers compared to marine species mainly because of their soft texture and muddy flavour (Yu 1991). In line with the goverment-backed policy of increasing the usage of freshwater fish as well as better utilization of trawl by-catch, this paper deals with the development of fishburgers from two such under-utilized species.

Materials And Methods

Fish

S. leptolepis was purchased fresh from the wholesale market and transported in ice to the laboratory for immediate processing.

A. nobilis was brought fresh from the farm to the laboratory. The weight of each fish was about 3-5 kg.

Preparation Of Surimi

The fishes were deheaded and gutted manually. The dressed fish were then washed and filleted. The fillets were then fed through a mechanical deboner (6 inches horizontal type fish meat separating machine, Taiwan).

The mince was washed twice in dilute saline (0.2 % and 0.3 %, consecutively) in order to remove odorous substances, blood pigments, lipids, and to increase the concentration of actomyosin which governs gel-forming characteristics. The mince was left in saline for 20 minutes until the meat settled and the supernatant then removed (Meat:chilled saline ratio 1:4). The washed meat was transferred to a thin cloth bag and spun using a leaching machine (Syarikat Perniagaan Timbang dan Sukat Ban Hing, Malaysia) to remove excess water. The washed meat was then blended with cryoprotectants (2.5% sucrose, 2.5% sorbitol) to prevent protein denaturation during frozen storage, and 0.2% sodium tripolyphosphate which can increase the water holding capacity of surimi. The surimi was then packed in polyethylene bags (thickness 0.08 mm) and blast frozen and stored at -20°C until further use.

Preparation of Fishburger

Six formulations of fishburgers were developed with *S. leptolepis* and *A. nobilis* ratios of 100:0, 80:20, 60:40, 40:60, 20:80, and 0:100. The semi-thawed surimi was ground with a food processor (National, model MK-5070N). The surimi was not thawed completely in order to prevent protein denaturation due to heat generated during grinding.

The ground surimi was then mixed with the ingredients as shown in Table 1, using a mixer (Kenwood, model SM-210). Fish paste weighing approximately 65 g were formed using a burger former (Safe World Enterprise (M) Sdn. Bhd.). In order to facilitate handling, the formed paste was blast frozen to -25°C before battering and breading. The fishburgers were then packed in polyethylene bags (0.08 mm) and stored at -20°C.

Table 1. Ingredients of fishburger formulation.

Ingredient	%
Paste	
Surimi	63.0
Vegetables mixture *(Grand Union, Malaysia)	16.0
Potato starch (Ming Kee Chan Sdn. Bhd., Malaysia)	6.0
Iced water	6.0
Vegetable oil (palm oil) (Lam Soon (M) Sdn. Bhd.)	3.0
Fish flavour (Damah Trading (M) Sdn. Bhd.)	3.0
Salt (Seng Hin Brothers (M) Sdn. Bhd.)	1.2
Pepper (Hock Seng Trading, Malaysia)	0.5
Garlic powder (Hock Seng, Malaysia)	0.5
Spices:cummin seed, aniseed, coriander, mustard seed (Kilang Tepung Sayidah, Malaysia)	0.4
Monosodium glutamate (Ajinomoto(M) Berhad)	0.2
Cinnamon powder (Hock Seng, Malaysia)	0.2
Batter	
Wheat flour (Malayan Flour Mill, Malaysia)	30.0
Corn flour (Brown & Polson Ltd., Scotland)	10.0
Water	60.0
Breading	
Bread crumb (J. Crumb Orange, Technofood Ingredients Trading, Malaysia)	

*diced carrots, corn kernels and green peas.

Recovery Studies

The weight of the fish at various stages of processing were recorded:
(1) weight of whole fish
(2) weight of dressed fish
(3) weight of fish fillet
(4) weight after deskining/deboning
(5) weight after washing.

Chemical Analyses

Triplicate samples were used to determine the chemical compositions of the fish mince, surimi, and fishburgers. Analyses for moisture, protein, fat,

and ash were done according to Pearson (1976). Amino acid analyses were done according to the method of PICO.TAG Amino Acid Analysis (Anon. 1990).

Sensory Evaluation

The fishburgers were deep fried in palm olein at 175°C for 4 minutes (Valentine fryer, Model T4BS, Switzerland) before sensory evaluation. Organoleptic evaluation for taste, color, flavor, juiciness, texture and overall acceptability was conducted by 15 experienced panelists. The product was evaluated using a 9-point Hedonic Scale (Appendix 1) of '9' for excellent and '1' for unacceptable (Kosmark 1986).

Market Trial

A market trial was carried out in the housing estates of Taman Sri Serdang, Taman Universiti and Taman Serdang Raya in order to determine acceptability, market potential and acceptable price of the fishburgers.

A sample size of 60 households was used. Each household received a survey sheet and self-addressed stamped envelope along with two fishburgers. Each sample was labelled stating the product's name, ingredients, instructions for preparation, and weight.

Data were analysed using the Analysis of Variance Method at 5% level of confidence (ANOVA). The statistical programme used was the Statistical Analysis System (SAS) (Bar *et al.* 1976).

Results and Discussion

Recovery Studies

As shown in Table 2, the recovery of dressed *S. leptolepis* was 72.47%, and 62.86% for *A. nobilis*. The yield of washed mince were 38.20% for *S. leptolepis* and 30.08% for *A. nobilis*. Yu (1991) reported that the recovery for *A. nobilis* after washing was 30.90%. Siti (1992) reported that the yield for *A. nobilis* was 31.17%. Recovery decreases upon washing due to loss of soluble proteins, fat, and also blood pigments. The low recovery of *A. nobilis* mince is due to its large head, hard scales and thick, tough skin.

Proximate Compositions of Fish Mince, Surimi and Fishburger

Compositions of fish mince were altered during processing (Table 3). Moisture contents increased after washing. Suzuki (1981) reported that washing generally increases hydrophilic properties of the meat mince which causes the muscle to swell and the removal of water difficult. Incorporation of NaCl in the washing water increases the efficiency of dewatering (Toyoda *et al.* 1992).

Washing also removes water-soluble nitrogen and this causes a reduction of protein. These nonproteinaceous substances are known to accelerate the denaturation of muscle proteins during frozen storage (Noguchi 1982).

Table 2. Recovery of fish mince from *S. leptolepis* and *A. nobilis*.

	S. leptolepis	*A. nobilis*
Whole fish	100.00	100.00
Dressed fish	72.47	62.86
Fillet	52.27	49.16
Deskined fish	45.06	37.95
Leached mince	38.20	30.08

Table 3. Proximate compositions of fish mince, surimi and fishburger.

	Moisture	Protein	Fat(%)	Ash
S. leptolepis				
mince before washing	78.19	16.20	4.05	1.48
mince after washing	84.82	14.87	1.24	0.67
surimi	83.55	13.90	1.15	1.27
A. nobilis				
mince before washing	76.10	15.90	5.95	1.65
mince after washing	82.95	14.85	1.86	0.74
surimi	81.98	14.06	1.48	1.34
Fishburger(fried)	74.38	13.82	9.06	2.76

A net reduction of 69.38% (*S. leptolepis*) and 68.73% (*A. nobilis*) in lipid and 54.73% (*S. leptolepis*) and 55.15% (*A. nobilis*) in ash content was observed after washing.

Amino Acid Compositions

Table 4 lists the amino acid compositions of *S. leptolepis*, *A. nobilis*, fishburger and beef. Major constituents are glutamic acid, aspartic acid, lysine, leucine and arginine. Results showed that the amino acid compositions of *S. leptolepis*, *A. nobilis* and fishburger were comparable to beef, which is the main ingredient in the manufacture of traditional burgers.

Sensory Evaluation

Sensory evaluation studies are of importance from the point of view of the processor as well as the consumers. Acceptance of a product as judged by sight, smell, and taste indicates consumer satisfaction and this is of value to the processor, since it ensures sales.

Results from sensory evaluation of the fishburgers is shown in Table 5. Statistically significant differences were not noticed with regards to taste and flavor. This indicates that the flavor of *A. nobilis* was reduced during washing. The undesirable flavor was also masked by flavour components in the formulation. However, significant differences were noticed in color of paste,

Table 4. Amino acid compositions of *S. leptolepis*, *A. nobilis*, fishburger and beef (value expressed as % of crude protein).

Amino acid	*S. leptolepis*	*A. nobilis*	Fishburger	(fried)Beef*
Arginine	6.4	7.3	6.7	6.6
Histidine	2.3	3.2	2.8	2.9
Isoleucine	4.1	4.2	3.7	5.1
Leucine	7.7	8.8	7.9	8.4
Lysine	8.1	5.3	7.8	8.4
Methionine	3.8	4.1	4.0	2.3
Phenylalanine	3.7	3.7	3.4	4.0
Threonine	4.3	5.5	4.4	4.0
Valine	3.9	4.7	4.3	5.7
Alanine	7.0	6.1	7.0	6.4
Aspartic acid	8.7	10.0	9.0	8.8
Cystine	0.3	0.5	N.D	1.4
Glutamic acid	22.4	18.5	20.5	14.4
Glyine	4.9	4.8	5.3	7.1
Proline	3.7	3.7	3.8	5.4
Serine	4.2	5.0	4.8	3.8
Tyrosine	3.6	4.0	4.1	3.2

N.D. - Not detectable
*(Sawyer 1975).

Table 5. Sensory evaluation of fishburgers made from *S. leptolepis* and *A. nobilis*.

Parameter	Ratio of *S.leptolepis* : *A.nobilis*					
	100:0	80:20	60:40	40:60	20:80	0:100
Taste	7.86a	7.75a	7.90a	7.84a	7.77a	7.69a
Colour	3.26d	4.18c	6.77b	6.81b	7.50a	7.89a
Flavour	8.11a	8.06a	7.93a	7.88a	8.01a	8.00a
Juiciness	6.07c	7.11b	8.09a	8.12a	6.12c	7.03b
Texture	6.96b	6.98b	7.78a	7.81a	6.23c	5.31d
Overall acceptability	6.21c	7.18b	7.96a	8.01a	7.16b	6.38c

Note: Means within a row followed by a common letter are not significantly different at 5% level of probability.

juiciness, texture, and overall acceptability. There were no significant differences in the formulations with ratios of 60:40 and 40:60 *S. leptolepis* and *A. nobilis* which received the highest scores. Due to considerations of costs of production and availability of raw materials, the formulation with 40% *S. leptolepis* and 60% *A. nobilis* was chosen for market trials.

Market Trial

Of the 60 questionnaires sent out, 48 were returned, ie. there was an 80% response. Some 60.4% of the respondents were middle class with an annual gross income of between US$6,000 and US$18,000.

(1) Product attributes (Fig. 1)

(a) Taste (Fig. 1a)

Some 16.7% of the respondents rated the taste as excellent, 64.6% rated it as very good and 18.8% deemed it acceptable. No respondents rated the taste as being either poor or terrible.

(b) Texture (Fig. 1b)

Some 62.5% of the respondents rated texture as just right, 22.9% felt it was slightly too soft while 2.1% felt that the texture was too soft. Some 12.5% were of the opinion that the texture was slightly too hard.

(c) Juiciness (Fig. 1c)

Some 58.3% of the respondents rated the product as very juicy, 22.9% felt it was slightly juicy while 14.6% rated it as acceptable. However, 4.2% felt that the product was slightly dry.

(d) Color (Fig. 1d)

After frying, the fishburger turned a very attractive golden brown color. Some 68.8% of the respondents agreed with this observation. Another 25% rated color as attractive while 6.3% rated it as acceptable. None of the respondents rated color as slightly unattractive or very unattractive.

(e) Overall acceptability (Fig. 1e)

Some 43.8% of the respondents rated overall acceptability as excellent while 39.6% rated it as very good. Another 16.7% felt that the fishburger is acceptable. No respondent rated overall acceptability as poor or terrible.

(2) Serving meal (Fig. 1f)

Some 43.8% of the respondents said that they will consume the fishburger for lunch, 20.8% felt it would be ideal for dinner while 18.8% preferred it as a snack. Some 14.6% said that they will likely consume the product for supper while 2.1% felt it is ideal for breakfast.

(3) Frequency of purchase (Fig. 1g)

Some 44.4% of the respondents said that they will buy the product 3 or 4 times in a year, 36.1% said that they will purchase it once in a month while 11.1% said that they will purchase fishburgers once in a year. Another 8.3% said that they will purchase the product once in a fortnight.

Although beefburgers are more frequently purchased by consumers at present, value-added products made from fish are becoming increasingly popular. There is a growing awareness that fish and fish-based products are healthier, with less saturated fat and cholesterol.

(4) Price (Fig. 1h)

Some 52.8% of the respondents were willing to pay US$2.24 to US$2.60 for a package of 10 pieces, 38.9% were willing to pay USD1.84 to US$2.20, and

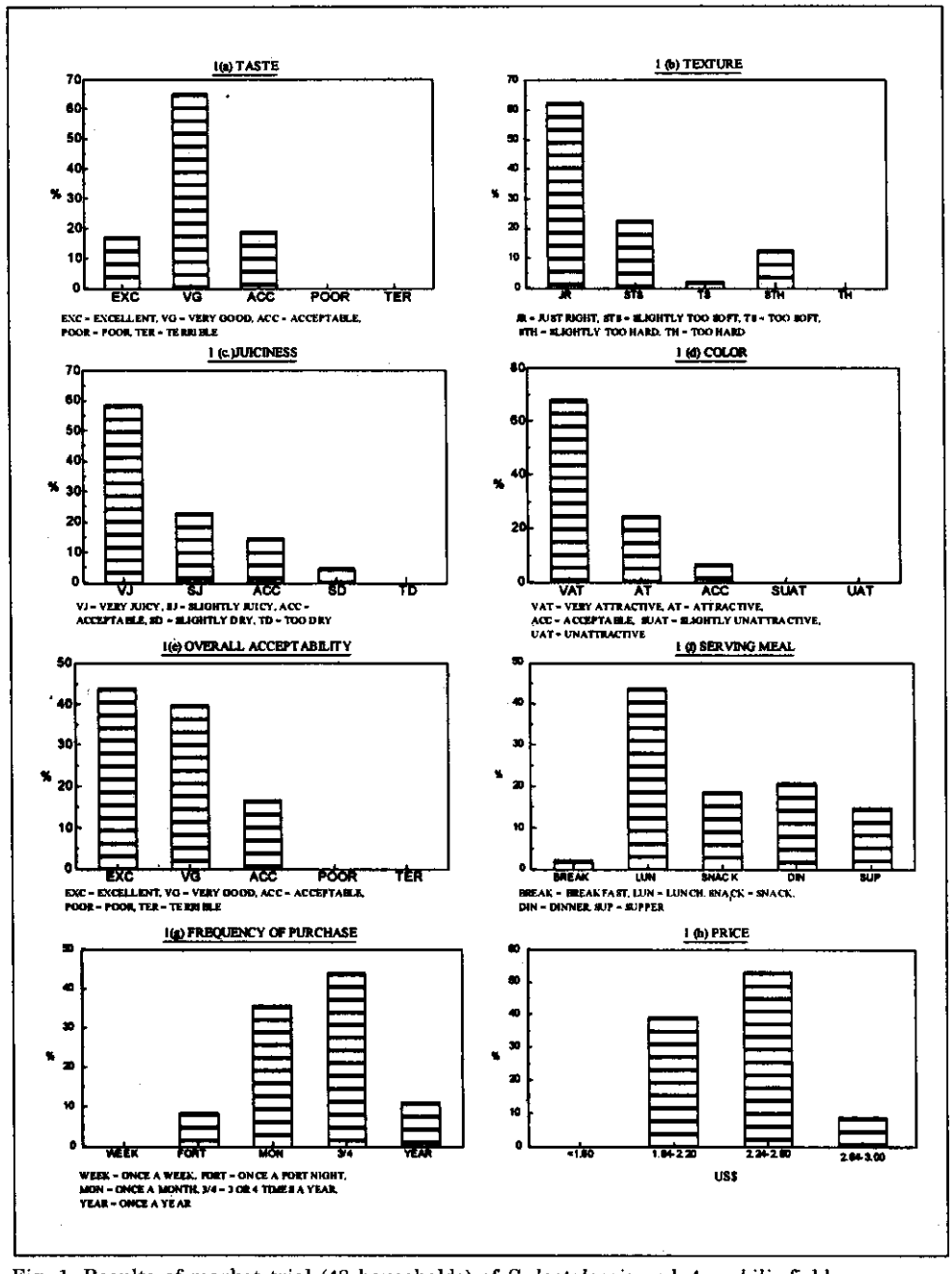

Fig. 1. Results of market trial (48 households) of *S. leptolepsis* and *A. nobilis* fishburgers.

8.3% were willing to pay US$2.64 to US$2.80. The price of US$2.24-US$2.60 is comparable to prices of beef burgers in Kuala Lumpur. However, fish burgers are generally more expensive, at around US$3.00.

Market Trial Conclusions

(1) Overall acceptability with respect to taste, texture, color and juiciness was very high.

(2) The market potential for this product is expected to be very good as 75% of the respondents were willing to buy this product if it becomes available in the market.

(3) The acceptable price range is US$2.24 to US$2.60.

Conclusion

Results showed that *S. leptolepis* and *A. nobilis* can be processed into highly-acceptable and nutritious fishburgers. Surimi-based gel products presently represent a suitable application for underutilized fish as surimi can be used in a wide range of products.

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