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Sensory, Biochemical and Microbiological Changes of Farmed Catfish (*Clarias batrachus*, Linnaeus) and Red Tilapia (*Oreochromis* sp.) at Ambient Storage

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ABSTRAK

Ikan keli (Clarias batrachus, *Linnaeus) dan tilapia merah* (Oreochromis *sp.) disimpan di suhu persekitaran (28±2°C) untuk selama 24 jam. Sampel di nilai bagi penerimaan, perubahan kesegaran, kehadiran ketengitan dan perubahan bilangan mikrob. Ikan keli masih diterima sehingga 20 jam dan ikan tilapia selama 15 jam penyimpanan. Ketika ditolak nilai K_1 ialah 70.0 dan 42.7% bagi tilapia dan keli masing-masing. Sampel ikan keli tidak melampaui bilangan mikrob 10^7 cfu/g hingga ke akhir masa penyimpanan; walaubagaimanapun, sampel tilapia telah melebihi bilangan mikrob dalam masa 20 jam.*

ABSTRACT

Farmed catfish (Clarias batrachus, *Linnaeus) and red tilapia* (Oreochromis *sp.) were stored at ambient temperature (28±2°C) for a period of 24 h. They were evaluated for acceptability, freshness deterioration, rancidity development and microbiological changes. Raw catfish was acceptable up to 20 h and that of tilapia up to 15 h. Upon rejection their K_1 values were 70.0 and 42.7% for tilapia and catfish respectively. Microbiologically, catfish samples did not exceed the 10^7 cfu/g limit until the end of the storage period; however, tilapia was not acceptable by the 20th hour.*

INTRODUCTION

Freshwater fish in Asian countries are distributed both in live and fresh form. No icing is practised when they are handled fresh. It could be that certain fishes, e.g. the catfish, are still alive 1-2 h after catch and can survive for 6-8 h in the open provided they are kept wet (Mohammad Mohsin and Ambak 1983). The effect of immediate icing on fish is well documented but less for tropical cultured fish. The lack of information on the quality deterioration of fish at ambient temperature, especially those of commercial significance in Malaysia makes it less conducive for the expansion and diversification of aquacultural activities. Therefore, this study was carried out to determine the chemical, microbial and sensory changes in farmed catfish (*Clarias batrachus*) and red tilapia (*Oreochromis* sp.) under ambient storage. The information gathered in this study could give some insight into the handling characteristics of these fishes prior to further processing.

MATERIALS AND METHODS

Sample

Farmed catfish and red tilapia were obtained from a nearby aquafarm and brought live to the faculty's laboratory. The catfish and tilapia were of commercial size, weighing 100-200 g and 500-1000 g respectively. They were not separated according to sexes.

Storage and Sampling

Upon arrival, the fishes were placed in dry trays at ambient temperature (28±2°C) and sampled at 4-h intervals. At each sampling time, eight fish of each species were sampled at random. Sampling for microbial count was first carried out on one side of the fish, followed by sampling for chemical indices. Out of the eight fish, three were put aside for sensory evaluation of raw samples.

Proximate Analyses for Protein, Fat and Moisture Content

The crude protein, moisture and lipid contents of the fish muscle were determined according to the procedure of Pearson (1976).

Sensory Evaluation of Raw and Cooked Samples

Sensory evaluation of the raw and cooked samples was carried out by eight semi-trained panellists (laboratory staff and students at the faculty). The raw samples were evaluated for changes in the eyes, gills, odour, and overall acceptability based on a 3-point hedonic score according to the procedure of Gorcyzca *et al.* (1985).

To evaluate cooked fish, a 2 cm cube of raw fish was placed in a glass petri dish with a cover. The sample was steamed for 10 min and served to the panellists while still warm. The sample was evaluated for odour (by sniffing when the cover was first opened partially), taste and texture based on a 7-point scoring system recommended by Kosmark (1986).

Thiobarbituric Acid Reactive Substances (TBARS)

The TBARS values in fish muscle were determined according to the procedure of Ke *et al.* (1984). The distillates collected were reacted with thiobarbituric reagent, heated to 100°C for 45 min and cooled under running tap water. The absorbance was read at 538 nm within 30 min and malonaldehyde (MA) concentration was obtained from a standard curve and reported as μmol MA/kg sample.

Quantification of ATP Catabolites and Determination of K_1-value

The nucleotides were extracted and prepared for high performance liquid chromatography (HPLC) following the procedure of Ryder (1985). The HPLC system used (LDC Analytical, CM 4000, Australia) was equipped with two pumps and an ultraviolet (UV) detector. The standards and the unknown were detected at 254 nm. Separation of standards was achieved on a reverse phase Lichrosorb RP-18 column (5 μm, 4.0 mm I.D x 25 cm, Merck, Germany). All nucleotide standards were obtained from Sigma (St. Louis, Missouri, USA). The buffer used was 0.04 M KH_2PO_4 and 0.06 M KH_2PO_4 in the ratio of 75:25 with a flow rate of 1.5 ml/min. The maximum absorbance sensitivity was set at 0.2 aufs. The K_1 -value was defined as the percentage of the sum of hypoxanthine (Hx) and inosine (HxR) to the sum of inosine monophosphate (IMP), HxR and Hx (Watanabe and Karube 1986).

Microbial Analysis

The total plate count of the samples was carried out according to AOAC (1984) using the pour plate method. Plates were incubated at 37°C for 48 h.

Statistical Analysis

Analysis of variance, Duncan's multiple range test and other relevant statistical analyses were carried out using the Statistical Analysis System (SAS) programme.

RESULTS AND DISCUSSION

The moisture content obtained for the catfish was 74.5±1.5% and that of tilapia was 77.2±0.5%. Their protein contents were 14.4.8±1.6% for catfish and 12.9±1.1% for tilapia. The lipid content of catfish was 2.2±0.4% and that of tilapia was 1.6±0.2%.

Fig. 1 and *Fig. 2* show the sensory scores for eyes, gills, odour and acceptability of the whole catfish and tilapia respectively. Very little changes in the sensory scores occurred (except for the gills) for the first 4 h in tilapia and for the first 8 h in catfish. Rapid decline in the scores for the eyes, gills, odour and acceptability were observed thereafter for both fish though the rate of decline was not similar. With the overall acceptability cut-off point set at 1.5, it could be said that tilapia was acceptable up to approximately 15 h and that of catfish up to 20 h of storage (though the acceptable condition of the eyes was only up to 12 h). Nile tilapia *(Oreochromis niloticus)* was reported to be rejected after 16.5 h of ambient storage with the development of putrid, bitter and itchy flavour, but no softening of the texture (Estrada *et al.* 1985). Jamilah and Yusoff (1993),

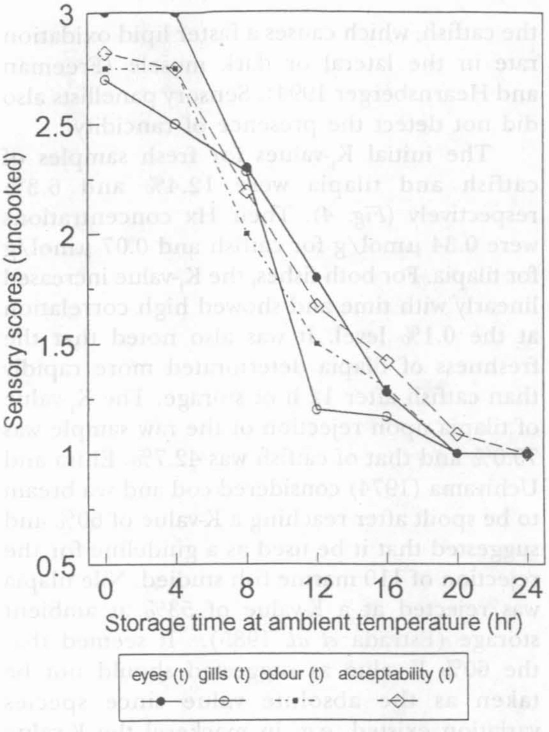

Fig. 1: Sensory scores of red tilapia kept at ambient temperature

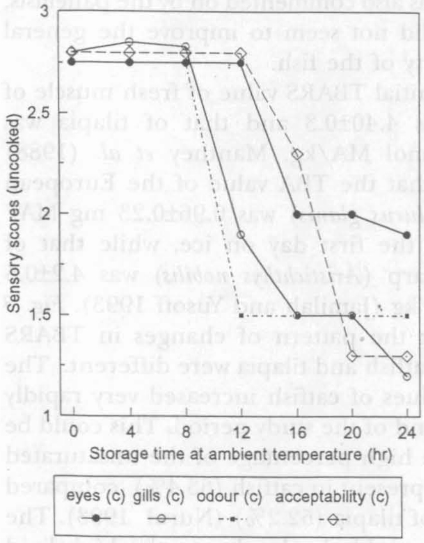

Fig. 2: Sensory scores of catfish kept at ambient temperature

in a study of bighead carp *(Aristichthys nobilis)* also found the acceptability of the fish to be at 12 h of storage at ambient temperature. Acceptable shelf-life of common carp *(Cyprinus carpio)* was reported to be 13 h (Gelman *et al.* 1990). From the few reports available, it seems that the shelf-life for freshwater fish at ambient storage (25-30°C) was 12-16 h. Development of the ammonical odour was obvious in both fish upon prolonged storage.

The results of the sensory scores for cooked samples were as in Table 1. The initial acceptability scores for tilapia were higher than for catfish. This could be due to the strong influence of the odour since odour in catfish was scored significantly lower than tilapia. Based on

TABLE 1

Sensory scores of cooked samples of tilapia and catfish after storage at ambient temperature

Storage time	Tilipia				Catfish			
(h)	Odour	Taste	Texture	Accept.*	Odour	Taste	Texture	Accept.*
0	6.0	5.5	6.0	5.8	4.8	6.3	5.0	5.3
4	5.3	5.5	6.5	5.8	4.5	4.6	6.0	5.0
8	4.5	4.8	5.5	4.9	4.0	4.3	5.3	4.5
12	4.3	4.5	5.3	4.7	4.2	4.3	4.8	4.5
16	2.5	1.8	5.0	3.1	3.8	4.2	4.0	4.0
20	1.8	1.3	3.6	2.2	2.5	3.8	3.7	3.3
24	1.5	1.3	3.1	2.0	2.3	3.2	3.2	2.9

* Overall acceptability

the rejection value of 3.5, the cooked samples of tilapia were acceptable up to slightly less than 16 h and that of catfish up to approximately 20 h. Odour seemed to be the most rapidly deteriorated parameter for both fish; this was also commented on by the panellists. Cooking did not seem to improve the general acceptability of the fish.

The initial TBARS value of fresh muscle of catfish was 4.40±0.3 and that of tilapia was 3.7±0.2 μmol MA/kg. Manthey *et al.* (1988) reported that the TBA value of the European catfish (*Silurus glanis*) was 0.96±0.23 mg MA/100 g for the first day on ice, while that of bighead carp (*Aristichthys nobilis*) was 4.2±0.5 μmol MA/kg (Jamilah and Yusoff 1993). *Fig. 3* shows that the pattern of changes in TBARS values of catfish and tilapia were different. The TBARS values of catfish increased very rapidly until the end of the study period. This could be due to the high percentage of the unsaturated fatty acids present in catfish (63.4%) compared with that of tilapia (52.2%) (Nurul 1993). The difference could also be due to the high lipid content and the presence of oxidation catalyst (Fe and Cu) in the dark muscle and the skin of the catfish, which causes a faster lipid oxidation rate in the lateral or dark muscle (Freeman and Hearnsberger 1994). Sensory panellists also did not detect the presence of rancidity.

The initial K_1-values for fresh samples of catfish and tilapia were 12.4% and 6.3% respectively (*Fig. 4*). Their Hx concentrations were 0.34 μmol/g for catfish and 0.07 μmol/g for tilapia. For both fishes, the K_1-value increased linearly with time and showed high correlation at the 0.1% level. It was also noted that the freshness of tilapia deteriorated more rapidly than catfish after 12 h of storage. The K_1-value of tilapia upon rejection of the raw sample was 70.0% and that of catfish was 42.7%. Ehira and Uchiyama (1974) considered cod and sea bream to be spoilt after reaching a K-value of 60% and suggested that it be used as a guideline for the rejection of 110 marine fish studied. Nile tilapia was rejected at a K-value of 53% at ambient storage (Estrada *et al.* 1985). It seemed that the 60% K-value as suggested should not be taken as the absolute value since species variation existed, e.g. in mackerel the K-value for the rejection was reported to be 53-76% (Barile *et al.* 1985).

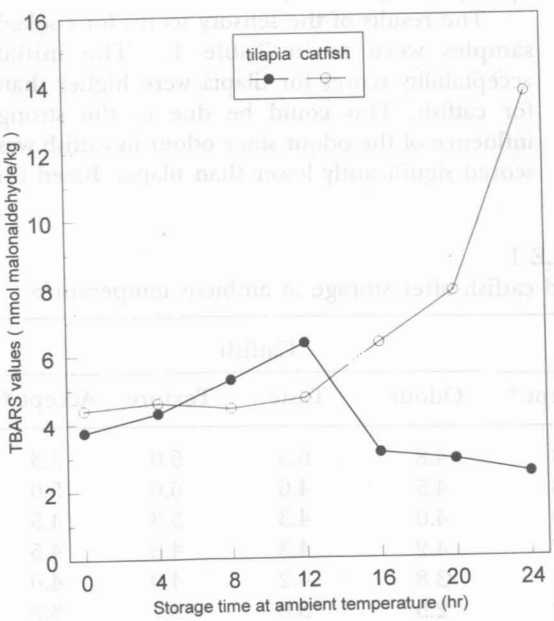

Fig. 3: TBARS values of tilapia and catfish kept at ambient temperature

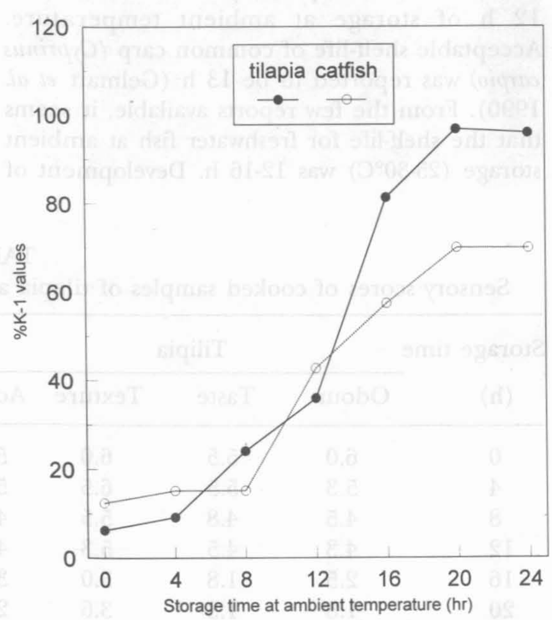

Fig. 4: K_1-values of tilapia and catfish kept at ambient temperature

From the microbiological standpoint, catfish samples were still acceptable at the end of the storage period since they did not exceed the maximum of 10^7 cfu/g for acceptability of freshwater fish as recommended by the International Commission of Microbiological Standards for Foods (ICMSF 1978) (*Fig. 5*). Tilapia samples had exceeded the 10^7 cfu/g limit by the 20th hour of storage. The sudden increase in the microbial count of the sample was also reflected by the sudden increase in the Hx content of tilapia, i.e. from 0.51 nmol/g at the 16th hour to 1.19 nmol at the 20th hour of storage. A similar observation was reported by Estrada *et al.* (1985) while working on *O. niloticus.* They suggested that the Hx formation at the later stage of ambient storage is probably due to the bacterial activity.

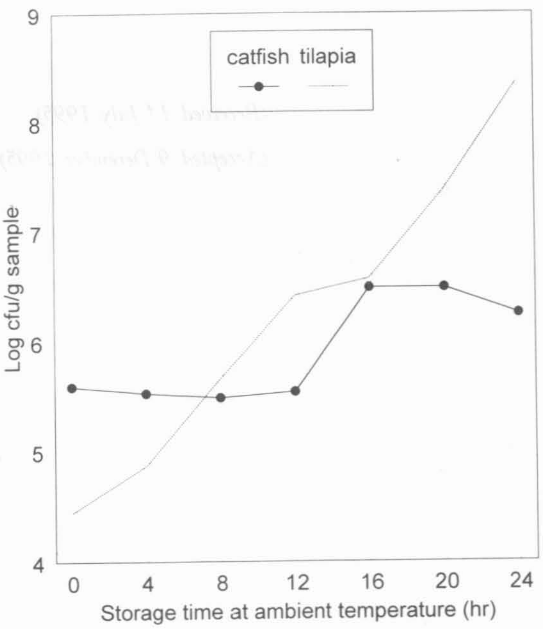

Fig. 5: Microbial count of tilapia and catfish kept at ambient temperature

CONCLUSION

The shelf-life of catfish and tilapia at ambient storage was 20 and 15 h respectively. Catfish with the initial TBARS value of 4.40 μmol MA/kg developed rancidity more rapidly than tilapia though sensory panellists did not indicate any detection of rancidity thoughout the study. However, tilapia showed a faster rate of freshness deterioration with a K_1-value of 70% upon rejection. Catfish was rejected at 42.7% K_1-value. The K-value of 60% cannot be used as the absolute value for the rejection of the two species of freshwater fish studied. The microbiological count of catfish did not exceed the 10^7 cfu/g at the end of the storage period, but the value was exceeded by tilapia by the 20th hour of storage.

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