Vet.Med.J.,Giza. Vol.53, No.4. (2005):1021-1029.

DEVELOPMENT OF SENSORY SCORING SCHEMES FOR FARM-RAISED FISH (TILAPIA NILOTICA AND BAGRUS BAYAD)

GEHAN M. KASSEM AND EMARA, M.M.T.
Department of Food Hygiene and Control, Faculty of Veterinary Medicine, Cairo University

Received: 17. 7. 2005
Accepted: 21. 7. 2005

SUMMARY

The aim of the present investigation is to establish a guide for the post-mortem changes in sensory characteristics of farm-raised Tilapia nilotica (*T. nilotica*) and Bagrus bayad (*B. bayad*) which are among the most popular Egyptian freshwater fishes. Fish under experiment were kept in crushed-ice and the changes in the different sensory criteria were followed during storage by sensory evaluation of the skin surface, gills, eyes, smell and muscles stiffness of raw fish, as well as the eating quality criteria (odor, flavor and texture) for cooked samples. Numerical schemes using simplified descrptive terms were developed to make sensory evaluation more reliable and facilitate its application in industrial field. The scales were constructed into many features and the final judgement was performed according to summation of all investigated characteristics. The quality grades of raw examined samples of *T.nilotica* and *B. bayad* were categorized as excellent (grade A =10 marks) for samples stored for first three days, very good (grade B = 8 marks) for samples stored for 7days, good (grade C = 6 marks) for samples stored for 9 days, acceptable (grade C = 4 marks) for samples stored for thirteen days, while samples stored for more than thirteen days in crushed ice were considered rejected (grade E =2 marks).

INTRODUCTION

Fish is a vital source of human food, where about one billion people world-wide rely on fish as their primary source of animal protein (FAO, 2000). Now-adays fish farming has been practiced to meet the increasing demand for fish and consequently quality of farmed fish becomes a developing area of concern (Kestin and Warriss, 2000).

Although safety is the Agency's highest priority, the consumer problem most frequently encountered with seafood is decomposition that affects

quality and fitness. This situation derives from the high perishability of seafood and sometimes long and difficult route that seafood must take from water to table (Olafdottir et al., 1998).

The evaluation of the quality criteria used to define the freshness of fish as well as the development of reliable methods for assessing this freshness is the goal of fish research. The methods for evaluation of fresh fish quality may be conveniently divided into two categories; sensory and instrumental. The most traditional method used for detecting decomposition is sensory examination. However, no single instrumental method is generally reliable for assessment of freshness and spoilage in seafood. Since the consumer is the ultimate judge of quality, most chemical or instrumental methods must be correlated with sensory evaluation before being used (Huss, 1995). Therefore, the trend is to standardize methodologies to make sensory evaluation on objective measurement to ensure uniformity of application of sensory testing (Hyldig and Nielsen, 1998; Nielsen, 1998, Kyrana and Lougovois, 2002).

Quality aspects that can be judged by sensory assessment are odor, color, appearance, flavor and texture. Moreover, sensory assessment is likely to predict the consumer's reaction towards fish and fish products better than non-sensory methods (Ashie et al., 1996; Luten et al., 1997).

The sensory quality of fish and fish products is important to describe the quality perception of the consumers, with eating quality being the most important component. Meanwhile, eating quality becomes unacceptable to the consumer as a result of various deteriorative changes attributed to the activities of bacteria which will be reflected on the other sensory aspects (Nielsen and Jessen, 1997). In this regard Giannini et al., (2001) emphasized the importance to ensure that seafood is really fresh before packaging so that it will not become stale when distributed and displayed.

The wide diverse in fish habitats, and feeding behaviour, make edible fish species in different catching areas differ greatly in their chemical composition, which is reflected on their spoilage pathway. These arrays between fish species necessitate a definite study for each fish species to evaluate its decomposition pattern (Michael 1996).

The frist detailed scheme was developed by Shewan et al. (1953), however, there is still shortage in scientific description of changes in sensory attributes of local fish species. Therefore, the primary purpose of the present study is to establish an objective sensory quality scheme for ice-kept-farm-raised Tilapia nilotica (*T. nilotica*) and Bagrus bayad (B. bayad).

MATERIALS AND METHODS

Samples

Two lots of *T. nilotica* and *B. bayad* were collected from the El-Zawya fish farm at Kafer El-Shiehk Governorate (Egypt) during summer season. The first lot composed of 108 specimens of *T. nilotica* fish, each of 250-350g, while the second one consisted of 83 specimens of *B. bayad* of 500-700g. Immediately after harvesting, Fishes were stored in alternating layers of crushed ice in plastic containers. The iced fish were delivered to the laboratory within 4 hours, where additional crushed ice were added, the containers were kept in refrigerator and allowed to drain freely. More ice was added to compensate the melted ice during storage time. The changes in sensory attributes of raw and cooked fish were objectively described immediately after harvesting and then daily till the fish became obviously decomposed.

The panelist team

Five to seven staff members of the food hygiene and control department, Faculty of veterinary medicine, Cairo University, with past experience in sensory evaluation of fish were asked to describe the sensory quality of fish samples through a given terms as well as their own terms.

Sensory evaluation of the fish

At each sampling time, 5 randomly chosen fish were used for assessment of the changes in their sensory quality. The fish were examined for changes in general appearance including description of the condition and color of skin, surface slime, smell (of skin & gills), eyes, color and odor of gills, muscle texture, viscera and belly flap. Moreover, cooked muscle samples were evaluated for odor, flavor and texture.

Each fish was described by the panelists, where the descriptive terms used as a guide to develop the scheme of sensory attributes for farm-raised ice kept *T. nilotica* and *B. bayad* were recorded. Such descriptive terms were developed from the schemes reported by Shewan et al. (1953), Howgate et al., (1992), and EC (1996).

Simplified freshness schemes for raw and cooked *T. nilotica* and *B. bayad* were developed after consultant the various scoring scheme mentioned above. The descriptions given in the developed simplified freshness schemes were arranged in the sequences of their occurrence during ice-storage from absolute freshness to putridity.

Cooking

At each sampling time, three specimen of each fish species flesh (100g) were obtained from the dorsal muscles and steamed at 100°C for 30 minutes, and its eating quality parameters (odor, flavor and texture) were immediately evaluated by

the panelist team.

RESULTS AND DISCUSSION

Freshness is a complex property which is difficult to define formally. Loss of freshness and the development of spoilage are the result of interlocking sequences of chemical and biochemical reactions accompanied by the effect of microbial metabolism in and on the fish tissue, which can fundamentally only be appreciated by the senses and be measured by the panelists. While non-sensory procedures can give only second and indirect measure of freshness (Connell and Howgate 1986).

Stale, bad or putrid fish are easily recognized by sight, smell or taste, and quality assessment of fish in this condition presents little difficulty. There are, however, many occasions when it is necessary to assess quality at some intermediate stage of loss of freshness or some intermediate state of deterioration which substantiate the necessity for development of standard and reliable sensory evaluation scheme to follow up changes in sensory quality of fish throughout its storage life. In this respect, Ashie et al., (1996) and Luten et al.,(1997) stressed the importance of assessing the sensory quality of the harvest on board and continued throughout the processing and distribution chain, where rapid decisions about quality are made on the basis of sensory assessment

The consistant pattern of changes which can be monitored by sight, touch, smell and taste of T.nilotica and B.bayad during ice-storage was described in table (1) and tabulated into rating scale in table (2). Simplified descrptive terms as no off-odour, slightly off-odour and strong off-odour were used to make sensory evaluation more reliable and facilitate its application in industerial field, instead of terms as acetamide-like, musty, and grassy odour mentioned in by Shewan et al., (1953).

The developed scale of sensory evaluation for raw samples was constructed into many features (general appearance, odor, texture, condition of the muscles and belly flab as well as flavor in cooked samples), but no scor is given to single feature and the final judgement was performed according to summation of all investigated characteristics. While in Shewan et al., (1953) schem each sensory attribute as general appearance, odor and flavor has separated score and can be used separatly to judje the fish quality. In this respect, Connell and Howgate (1986) stated that there were advantages in measuring freshness on account of all characters because different storage conditions, can affect the separate single characteristic differently. The scales were anchored at the very fresh with a score of 10 and at 2 for obvious putrid fish.

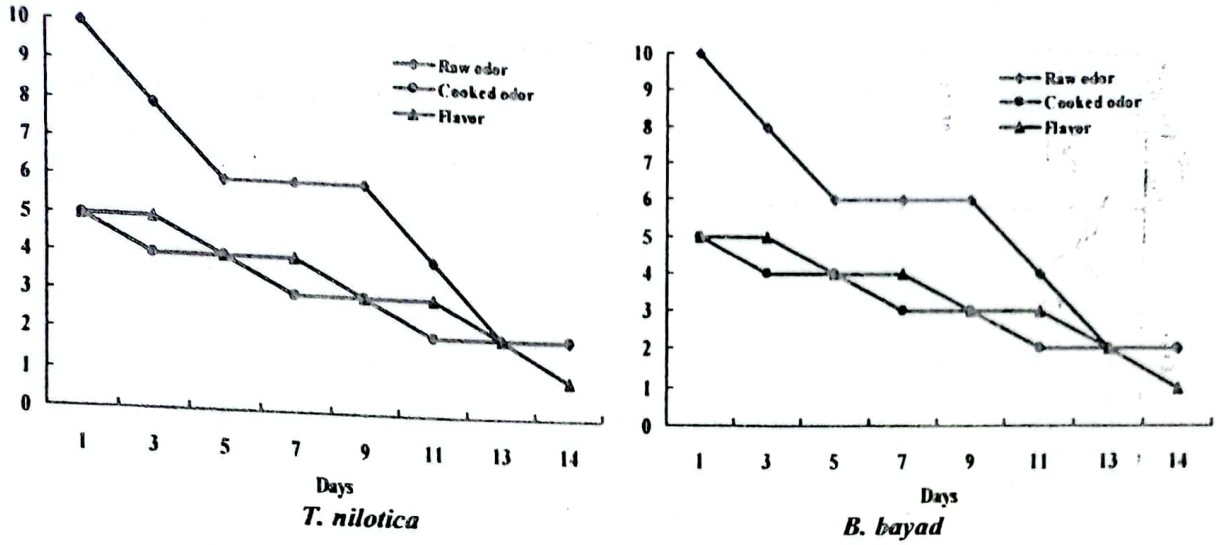

Figure (1): The relation between the sensory attributes used in sensory evaluation of raw and cooked samples.

The quality of examined samples of *T.nilotica* and *B.bayad* was categorized as excellent (grade A =10 marks) for samples stored for first three days, very good (grade B = 8 marks) for samples stored for 7days, good (grade C = 6 marks) for samples stored for 9 days, acceptable (grade D = 4 marks) for samples stored for thirteen days, while samples stored for more than thirteen days in crushed ice were considered unaccepted and rejected (grade E =2 marks).

Althougth sensory evaluation of cooked samples is neglicted, it is easy to perform and does not require special instruments. Data in table (3) revealed changes in eating quality parameters during ice storage of both *T.nilotica* and *B.bayad*. The score scale for cooked fish was rating with 5 for absolute fresh and 1for obvoius putried fish as shown in table (4). According to the panalists evaluation, the fish was accepted as Grade A (excellent at 5-4 scor), Grade B(good at 3 scor), while Grade C (acceptable at 2 scor) and rejected at one scor (grade D). The obtained results also clearly indicated that *B. bayad* revealed slightly rancid odour and flavour in Grade C and become more evidant at rejection time. FAO (1996) illustrated the eating quality parameters into four stages: First, fish is very fresh and has a fresh fishy taste, while in the second stage, some loss of odour and taste characteristic to species but no off-flavours could be detected and the texture is still pleasant. Where as the signs of spoilage and a range of volatile, unpleasant-smelling odor is slightly produced in the third stage, the texture became tough and dry. Moreover, a marked spoilage signs could be easily observed in the last fourth stage.

Table (1): Description of freshness grades for T. nilotica & B. buyad storedin crushed ice.

	Days post-harvesting							
	1	3	5	7	9	11	13	14
I. General appearance ° **Skin**	Bright, shining & Transparent, watery, clear slime	Bright, shining & Thin, watery, clear slime	S. loss of skin brightness & S. viscous turbid slime	S. bleaching skin with viscous, turbid slime	Loss of brightness, & Thick turbid slime	Dull, some bleaching & Turbid, thick slime	Dull, marked bleaching & very thick turbid slime	Dull, marked bleaching, shrinkage Stick thick clotted slime
° **Eye**	Convex, full Bright, black pupil, translucent cornea	Convex, full Bright, black pupil, translucent cornea	S. Convex, black pupil, V. S. dull cornea	S. flattened, grey pupil, S. opaque conrnea	flattened, grey pupil, S. opaque cornea	Sunken, grey pupil, opaque cornea	sunken, cloudy pupil, opaque cornea	Completely sunken, V. cloudy pupil, dull cornea
° **Gills**	Red & thin translucent watery mucus	S. loss of red color, thin & mucus	Pink-pale pink & thready mucous	Pink-pale pink & thready mucous	Pale pink & thready mucus	S & thick tready mucous	Greyish red and thick thready cloudy mucous	Greyish brown & thick brown mucus
II. Smell (gill & skin)	Fresh	Some loss of fresh odor	loss of fresh odor but no off-odor	Neutral (no off-odor)	V. S. fishy odor (S. rancid)	Strongly fishy odor (S. rancid)	S. off-odor (S. rancid)	Offensive odor (***rancid***)
III. Body texture	Stiff and firm return after finger pitting	Stiff and firm return after finger pitting	firm, elastic return after finger pitting	firm, elastic re-turn after finger pitting	Moderate return after finger pitting	S. firm, slowly return after finger pitting	S. Flabby, V. slowly return after finger pitting	Flabby, slowly return after finger pitting
IV. Muscles	Translucent, strong-ly attached to back bone	Translucent, F. attached to back bone	Loss of transparency F. attached to back bone	S. opacity, S. loose from vertebral column,	S. opaque, loosely adherent to vertebral column, some reddening around the back-bone	Opaque, loosely adherent to vertebral column, red discoloration around the back bone	Completely opaque, loosen, dark red discoloration around the back bone	Completely opaque, lacerated, brown discoloration around the back bone
V. Belly flab	Firm & translucent,	Firm & translucent	Less firm, with S. discoloration,	S. soft, with S. discoloration	S. Soft, opaque with greyish discoloration	Soft, marked discoloration	S. breakage of skin with yellowish discoloration	Lacerated with yelowish brown discoloration

S. slight **V. very**

Table (2): Freshness scoring scheme for sensory characteristics of fresh *T. nilotica* and *B. bayad* stored in crushed ice.

Sensory characteristics	Score
Slight, shining skin, transparcnt watery clear outer slim Convex black pupil, full bright eye, translucent cornea Bright red gills, translucent watery mucus, fresh odor Fresh odor Firm body, translucent muscles strongly attached to bones, no discoloration along the back-bonc Firm belly flab with no discoloration.	Excellent 10
Slight loss of skin brightness, thin, viscous & slightly turbid outer slime Slightly convex, very slight grey pupil and Slightly opaque cornea Slight pale pink gills, thready mucous Some loss of fresh odor Firm body, slight lose muscles transparcncy, firmly attached to bones, no discoloration along the back bone Firm belly flab, no discoloration.	Very Good 8
Loss of skin brightness, viscous, turbid outer slime flattened eye, slightly grey pupil, dull cornea Pale red gills with htread, mucous, fishy odor Loss of fresh odor but no off-odor Moderate firm body, very slight muscle opacity, very slight loose from vertcbral column, very slight discoloration along the back-bone Slight soft belly flab, slihgt discoloration.	Good 6
Dull skin, thick, very slight bleaching turbid outer slim Sunken eye, vloudy pupil, opaque cornea Grey-red gills, thready mucous, slight offensive odor Strongly fishy odor (slight rancid odor in *B. bayad*) Slightly firm body, slowly retained after finger pressure, opaque muscle loosely adherent to vertebral column, some reddening around the back-bone	Acceptable 4
Linit of acceptability	Rejected 2
Dull skin some, some bleaching	

Table (3): Description of freshness grades for cooked *T.nilotice* and *B. bayad*

	Grade	A	B	C	D
	Score	5-4	3	2	1
Flavor	*T. nilitica*	Very fresh characteristic to species	Loss of flavor	Slightly off-flavor	Strong off-flavor
	B. bayad	Very fresh characteristic to species	Loss of flavor	Slighty off-flavor (rancid)	Strong off-flavor (rancid)
Odor	*T. nilotica*	fresh characteristic to species	Loss of characteristic odor	Slight off-odor	Strong putrefied odor
	B. bayad	Fresh oily characteristic to species	Slight oily odor characterisitc to species	Slight rancid odor	Strong rancid odor
Texture	*T. nilotica*	Elastic, firm	Elastic, firm	Elastic and less firm	Less elastic
	B.bayad	Elastic, flaky	Elastic, flaky	Elastic, less flaky	Less elastic

The relation between the different quality characteristics showed that raw odour scores lies within the same range as cooked scores (figure1-A,1-C). Moreover, odour and flavour of raw and cooked samples are about equally, well correlated with the age of the fish (figure1-B,1-D). On the other hand, raw texture score decreases slowly with the extenstion of storage, a matter which make texture unaccurate criteria for distingueshing between fish that are not definitely stale.

The data obtained during the present study tables (1-4) indicated that no difference could be detected in storage life of *T.nilotica* and *B.bayad*, although *T.nilotica* belong to lean fish and *B.bayad*, to fatty fishes. This may be referred to difference in fish size which affect the rate of decomposition, where B. bayad samples are larger (500-700g) than those of *T. nilotica* (250-350g). In this regard, Davis (1995) stated that small fish are more quickly affected by inward diffusion by metabolic products of bacterial activity than large size fish.

In general, spoilage pattern can be summarized as decline in the fresh characteristic odor and flavour through a neutral phase, followed by increasing off odor and off-flavour and eventual markedly spoiled. In many fish species, the same underlying processes still occur, but other factors mostly compositional, causing subtle additions to or may overwhelm that common pattern. So further studies are required to ascertain the validity of the developed schemes to evaluate the sensory quality of other local fish species.

REFERENCES

Ashie, I.N.A., Smith, J.P. and Simpson, B.K. (1996): Spoilage and shelf life extension of fresh fish and shellfish. Cri. Rev. Food Sci. Nut. 36, 87-121.

Connell, J.J and Howgate, P.F (1986): Quality control in the food industry. Edit by Herschdoerfer, S.M. Vol. 2(food science and technology) 2nd Ed. Academic press.

Davis, H.K. (1995): quality and deterioration of raw fish. In fish and fishery products composition, nutritive, and stability. Ed. By Ruiter, A. CBA international

European council (EC) (1996): freshness rating for white fish. Council Regulation No. 2406/96 of November.

FAO "Food and Agriculture Organization of the United Nations" (1996): Quality and quality changes in fresh fish. FAO fisheries technical paper 348.

FAO "Food and Agriculture Organization of the United Nations" (2000): The State of World Fisheries and Aquaculture 2000. FAO, Rome, Italy.

Giannini, D.; Parin, M.A.; Gadaleta, L.; Carrizo, G. and Zugarramurdi, A. (2001): Influence of raw material quality on quality of iced and frozen white fish products. J. Food Quality, 24: 527.

Howgate, P.; Johnston, A. and Whittle, K.J. (1992): Multilingual Guide to EC Freshness Grades for Fishery Products. Ministry of Agriculture, Fisheries and Food, Aberdeen, Scotland

Huss, H.H. (1995) Quality and quality changes in fresh fish.

Food and Agriculture Organization of the United Nations, Rome, 1995: FAO Fisheries Technical Paper No. 348.

Hyldig, G. and Nielsen, J. (1998): A rapid sensory method for quality management. In Methods to determine the freshness of fish in research and industry. Institut International du Froid, Paris, pp 297-305.

Kestin, S. and Warriss, P. (2000): Farmed Fish Quality. Fishing News Books Ltd

Kyrana, V.R and Lougovois, V.P. (2002): Sensory, chemical and microbiological assessment of farm-raised European sea bass (Dicentrarchus labrax) stored in melting ice. International Journal of Food Science & Technology, 37: 319.

Luten, J.B., B¯rresen, T. and Oehlenschl‰ger, J. (1997): Seafood from Producer to Consumer, Integrated Approach to Quality. Developments in Food Science 38. Amsterdam: Elsevier.

Michael, F. M. D. (1996):Subcommittee on livestock, dairy and poultry. Deputy commissioner for operations food and drug administration, Department of health and human services.

Nielsen, J. (1998): Sensory analysis of fish. In Methods to determine the freshness of fish in research and industry. Institut International du Froid, Paris, pp 279-286¥.

Nielsen, J., Jessen, K. (1997): New developments in sensory analysis for fish and fishery products. In Luten, J.B., Brresen, T. and Ochlenschlkger, J. (eds.). Seafood from producer to consumer, integrated approach to quality. Dev. Food Sci. 38, 537-547.

Olafdottir, G, Luten, J., Dalgaard, P., Careche, M., Verrez-Bagnis, V., Martinsdottir, E. and Heia, K. (1998): Methods to Determine the Freshness of Fish in Research and Industry. Int. Inst. Refrig. Paris, France.

Shewan, J. M.; Ruth, G.; Tucker, C. G. and Ehrenberg, A. S. C. (1953): A numerical scoring system for the sensory assessment of the spoilage of Wet white fish stored in ice. J. Sci. Food. Agric., 4: 283.