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Organoleptic and Shelf Life Quality of Shiner (*Auxis Thazard*) Smoked at Different Moisture Levels

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Abstract
Organoleptic (sensory) and shelf life quality of 27 fishes (*auxis thazard*) collected from local markets of Owerri municipal were determined for 21 days after smoke drying in a conventional kiln at Anambra Imo River Basin Development Authority (AIRBDA), Owerri. Samples were divided into three parts, each part was smoked for 24, 48 and 72 hours. Mean was used to analyse the data obtained. Nine (9) trained panels of judges analysed each set of samples for taste, texture, odour and physical appearance producing mean values of 4.0±0.67, 2.89±0.74, 1.89±0.74 and 3.33±0.67 respectively for sample A, 3.89±0.74, 3.67±0.47, 3.0±0.67 and 4.0±0.67 for sample B and 3.44±1.17, 4.33±0.47, 3.44±1.07 and 2.44±1.07 for sample C respectively. Shelf life of samples revealed sample A wrapped in plastic bag and paper lasted for 2 days and 5 days respectively before odour changed to smelly. Sample B showed shelf life to be 11 days and 15 days while Sample C on the other hand lasted for 18 days and all through the three weeks of the experiment, maintaining taste, texture and odour except for colour. It is recommended that to reduce preservation costs and maintain quality in the face of lack of electricity and occasional food scarcity, consumers should increase their diversity of fish food choices to consuming preserved *Auxis thazard* that have been dried for at least three days.

Keywords: Organoleptic quality, Shelf life, *Auxis thazard*, Smoke dried fish**,** Nutrition

Introduction

The need to meet the nutritional requirement of the teaming population that is always on the increase cannot be over-emphasized. Ernest Umakhihe, (Permanent Secretary of the Federal Ministry of Agriculture and Rural Development) in his address at a conference held at Abuja on Transformation and Future of Aquatic food System in Nigeria opined that Nigeria annually produces 1.1 million tons of fish, creating a deficit of 2.2 million tons, as the total demand stays at 3.6 million tons (Ships & Ports, 2021). Maintenance of imported frozen fishes such as Scumbia (*Scomber scombrus*,) shiner (*Auxis thazard*), Cod (*Gadus morhua*), and Kote (*Ethmalosa fimbriata*) amongst others requires the availability of a consistent supply of electricity and availability of refrigerating devices at all times. Processing/drying/smoking of such fish is done differently to ensure quality maintenance and prolong its shelf-life based on the fish species and the desired type of product (Chukwu & Shaba, 2009). Nigeria in its uniqueness has the most commonly employed technique for preserving fish to be smoking as it is cheap, easily available, products have wide acceptance, increases utilization and allows for product availability during lean seasons (Doyle, 2007). In their report, Ighodaro and Abolagba (2010), report that smoking diminishes the fish moisture content to a level that the activities of microbes that cause spoilage are inhibited. Smoking helps prevent deterioration and helps extend the shelf-life of fish (Okonta & Ekelemu, 2005). The concept of shelf life is employed to guarantee the safety and quality of food products before they are released to consumers. Throughout the shelf life of a food product, it is expected to remain safe for consumption, maintain the anticipated quality characteristics associated with the product, and contain the nutritional compositions as indicated on the labels (Vongsawashi et al., 2008).

Mackerel, which is also called Shiner (*Auxis thazard*) is one imported fish that is readily available and relatively cheap and tasty compared to other imported fish species (preliminary investigations, September 2022). The widespread extent of poverty in Nigeria as stated by Agom et al. (2012), and the corresponding safe state for its

consumption seem to have influenced the preference for fish over meat as a readily available source of protein in many households. This is due to the perception that frozen fish is relatively more affordable compared to beef or poultry meat in every sense of it. The fish, at its initial spoilage stage, especially in its frozen form, presents a look of freshness, its original state only to be detected when it has de-frozen in the hands of the consumers (FAO, 2013). The period for the whole fish to get frozen and stay frozen has a large bearing on the quality of the by–products. This fact is hardly impossible within the shores of the nation as we are laden with the problems of infrastructure, electricity and handling down the supply chain. The quick deterioration of fish is inevitable in this present challenging condition as they become predisposed to microbial invasion and proliferation (Okonta & Ekelemu, 2005).

Sensory alterations pertain to the changes in appearance, texture, odour, and taste as perceived by the senses (Iwe, 2010). These alterations include the browning or darkening of muscles through Maillard reactions as seen when exposed to increased temperatures, or enzymatic activity. In addition, there is the release of mucus, predominantly composed of mucin, accompanied by the emission of an unpleasant odour (Gill & Barbosa 2011). Moreover, sensory changes encompass phenomena like muscular withdrawal or gaping and the occurrence of burst bellies, also known as burnt bellies. These effects are attributed to the activity of digestive enzymes in the fish gut that are present (Huss, 1995; Singh & Benjakul, 2018). As a consequence of swift population growth, estimated at 2.3 percent annually from 2010 to 2030, there is a projected substantial increase in total consumption demand of food of fish origin. World Bank (2013) anticipates the population expansion to grow by 30% between the years 2010 and 2030. The South Eastern region of Nigeria is densely populated with individuals displaying a distinct preference for fish flesh over beef, as noted in Emere and Dibal (2013). Numerous diets within this locality prominently feature fish in its various forms. Fish also constitute a major delicacy during all occasions especially the frozen form as reported by Agom et al. (2012) who noted that some fish like croaker and mackerel have their most supply during the festive season and off the market or are scarce during non-festive seasons. At this rate of consumption, there is a need to investigate the sensory quality and shelf life quality of *Auxis thazard*, commonly consumed frozen fish preserved in our locally acceptable way. This study therefore sought to determine the shelf life of *Auxis thazard, (*locally called shiner) smoked at different moisture levels while noting its organoleptic quality as it is preserved in different packages.

Materials and Methods

Twenty-seven pieces of frozen *Auxis thazard* [shiner] of average weight 28.18g and length 31.97cm were purchased from Owerri market and transported in a cooling box to maintain temperature to Anambra Imo River Basin Development Authority, Owerri fish processing unit for smoke drying. The samples underwent a comprehensive washing process before being arranged on the racks inside a traditional smoking kiln. The smoking was done 10cm above the heat source. After placing the washed fish sample in the smoking kiln, the temperature of the kiln was adjusted to approximately 75^0c and 100^0c throughout the smoking period during the day and reduced during the night to between 40^0c to 50^0C. Fish samples were occasionally upturned mid-smoking to allow for all parts of the fish to get smoked and provide for a good appearance and texture of the final products. Samples comprising of 9 pieces of the fish were removed after every 24-hour interval, such that the second nine sets were removed the next day and the last 9 pieces removed on the third day coded samples A, B and C respectively. Samples per set were divided into three sections- a section cut into pieces for the sensory panel, another section was wrapped in a sterilized polythene bag and the last section was wrapped in a white paper.

Sterilized transparent polythene bags were obtained from the market that were still in their original outer packaging. The white paper was thorn out of a new 80 leaves long note from the centre, mimicking what is obtainable in almost all homes without refrigerators. These packaging materials were kept safe in a box until needed. The sensory/organoleptic evaluation of the oven-dried sample was conducted by a panel of nine trained judges selected from the Biology Department of Alvan Ikoku Federal College of Education, the present-day Alvan Ikoku University of Education and Anambra Imo River Basin Development Authority, Owerri. The oven-dried fish was served to the panellists for assessment. The questionnaire prepared using a five (5) point hedonic scale as described by Eyo (2001) was utilized by the panellists and grades were allotted based on their perceptions independent of one another.

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Table 1: 5-point hedonic scale for sensory parameter evaluation.

Points	Remark
0-1	Bad/poor
1.9 – 2	Fair
2.9 – 3	Good
3.9 – 4	Very Good
4.9-10	Excellent

The sensory evaluations were conducted after each smoking session according to the experimental design and continued at three-day intervals throughout the experimental sampling period of twenty-one (21) days. To prevent carryover flavours during testing, precautions were taken to ensure that all panellists made their evaluations on the days testing was expected. Sensory evaluation was done every three days and average results were produced.

While sensory analysis starts on the very first day, samples wrapped in sterilized polythene bags and those wrapped in white paper were placed on a shelf at room temperature to mimic the conventional method of keeping fish at home and then viewed every three days to note changes in texture, taste, odour and physical appearance. Changes in fish samples were recorded as pictures were taken. Samples that had gotten bad were immediately discarded to avoid contamination of other samples. Shelf life was checked for three weeks to ascertain how long the samples could stay maintaining their flavour without refrigeration. Data obtained were tabulated and analysed using mean and standard deviations. Charts were used to give a better representation of the obtained data.

Results

Table 2: Mean organoleptic/sensory quality of samples immediately after smoke drying

Samples	Taste	Texture	Odour	Physical appearance	Total	Remarks
A (Day 1)	4±0.67	2.89±0.74	1.89±0.74	4.33±0.67	3.03	Good
B (Day 2)	3.89±0.74	3.67±0.47	3.0±0.67	4.0±0.67	3.64	Good
C (Day 3)	3. 44±1.17	4.33±0.47	3.44±1.07	2.44±1.07	3. 41	Good

All samples smoked presented an overall good organoleptic quality, however, sample B smoked for two days presented a better organoleptic quality (3.64) over samples A and C smoked for a day and three days respectively.

Table 3; Mean organoleptic quality showing shelf life over days of preservation

Parameters	Package /Days	A							B							C						
		3	6	9	12	15	18	21	3	6	9	12	15	18	21	3	6	9	12	15	18	21
Taste	Polythene	2	0	0	0	0	0	0	4	2	0	0	0	0	0	4	4	4	4	3	3	2
	Paper	2	1	0	0	0	0	0	4	3	1	0	0	0	0	4	4	4	4	4	4	4
Texture	Polythene	3	2	2	0	0	0	0	4	3	2	1	0	0	0	4	4	4	4	3	3	2
	Paper	3	3	3	0	0	0	0	4	4	3	2	1	0	0	4	5	5	5	5	5	5
Odour	Polythene	3	1	0	1	0	0	0	3	3	1	0	0	0	0	4	4	3	3	2	2	2
	Paper	3	2	0	1	0	0	0	3	3	2	1	0	0	0	4	4	4	4	4	4	3
Appearance	Polythene	5	3	0	0	0	0	0	4	3	2	0	0	0	0	4	4	4	2	2	1	0
	Paper	5	4	2	0	0	0	0	4	4	3	2	0	0	0	4	4	4	4	4	4	2

The shelf life quality of the samples showed increasing quality in sample C and quality decreased as the day proceeded. Sample C had the best quality of "5" persisting up until the 21st day in the samples wrapped in paper. Overall, paper wraps had a longer shelf life than polythene bag wrappings. The appearance of sample C which presented the best sensory quality however reduced as the experiment proceeded, taste was however very good all through the experimental days. Quality comparisons over the 21 days for the three sets of experimental fish are presented in the table above.

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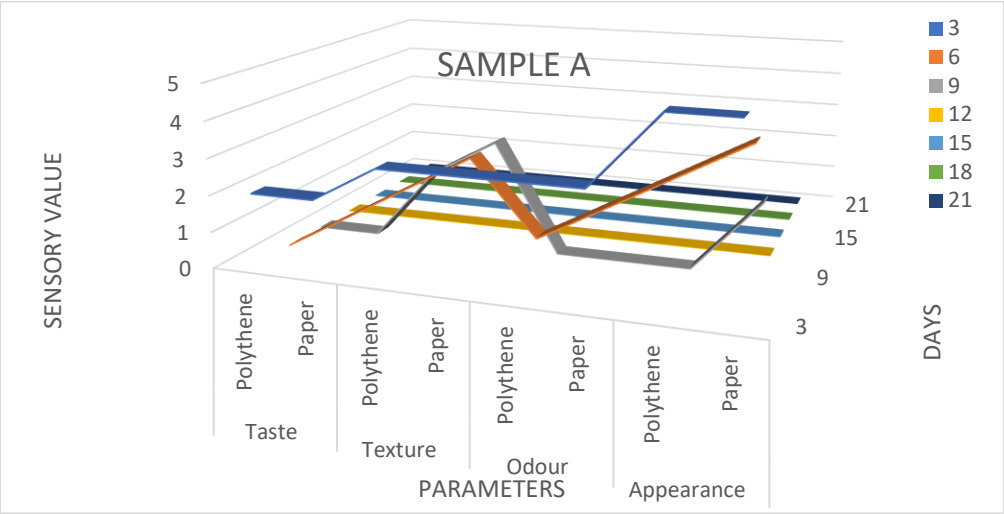

Fig. 1: Chart showing sensory progression and shelf life of Sample A (smoked for a day)

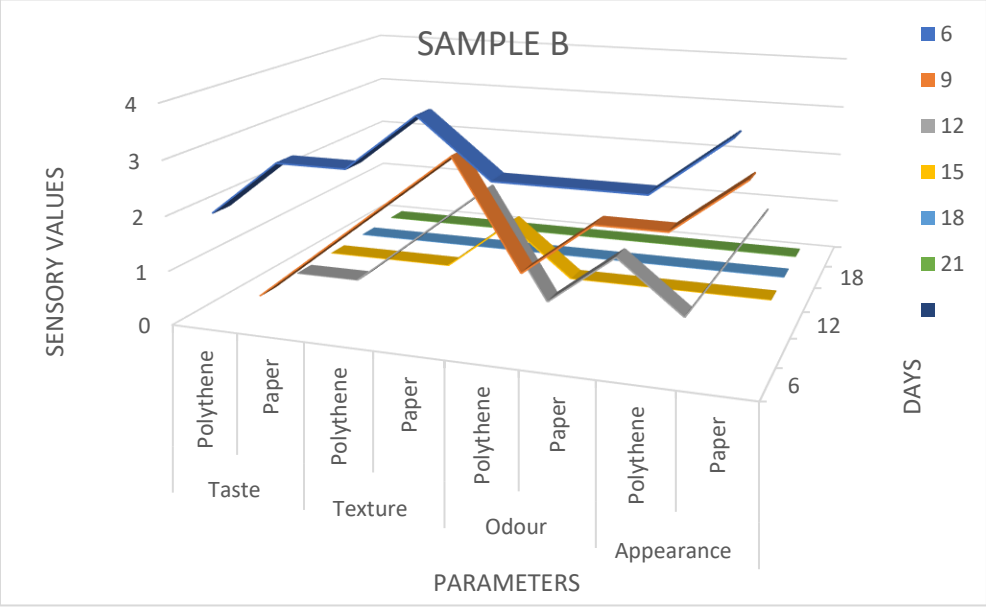

Fig 2: Chart showing sensory progression and shelf life of Sample B (smoked for 2 days)

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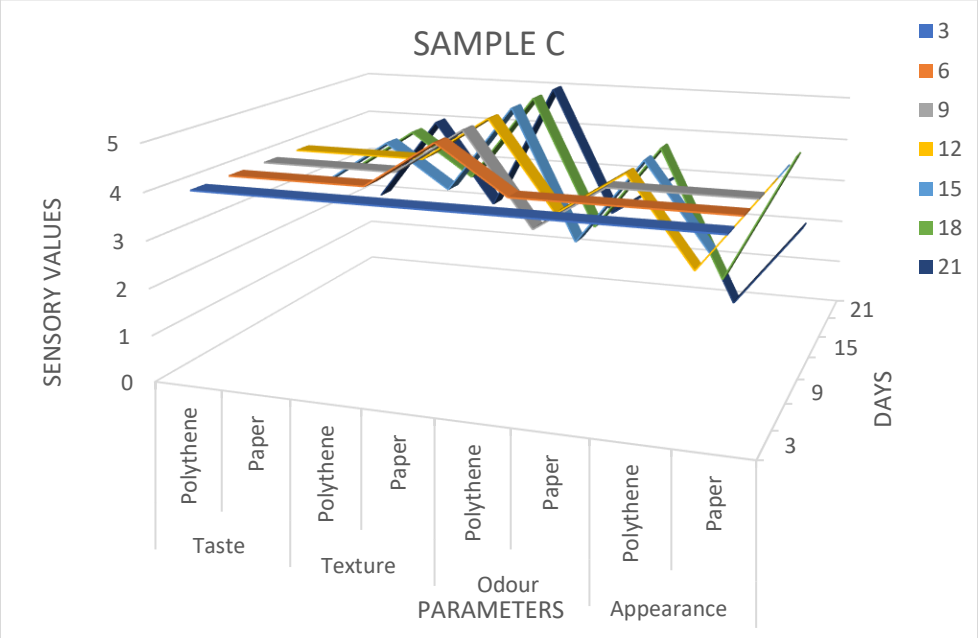

Fig 3: Chart showing sensory progression and shelf life of Sample C (smoked for 3 days)

Discussion

Sensory evaluation otherwise called organoleptic evaluation is widely regarded as the most valuable and reliable criteria for assessing the freshness level and determining the overall quality of a product. Sensory quality assessment serves as a simple, rapid, and effective method for gauging the quality of a product as humans can identify defects through visual cues indicating deterioration, including signs of freshness loss and changes observed during storage. This is because sensory analysis relies on the response or inclination of sensory organs to perceive and accept food products (Mosarrat, 2016).

Sensory analysis is typically defined as a "scientific method that elicits, measures, analyzes, and interprets people's responses to products perceived through the five senses that involve the eyes for sight, nose for smell, skin for touch, tongue for taste, and ear for hearing (Stone et al., 2012). The Quality Index Method (QIM) employs a categorical scale, where the system evaluates variations in the extent and pace of critical criteria, enabling their conversion into corresponding days of storage and remaining shelf life (Martinsdóttir et al., 2001). Smoked fish is highly sought after due to its improved flavour and texture, offering an enhanced sensory experience as it also protects against microbiological, enzymatic, and chemical deteriorative changes in the fish (Sowumi, 2007).

Results indicate the best quality for fish smoke-dried for two days at the initial point of removal from the kiln and wrapped in paper. Packaging system has a great bearing on the quality of products in the long run. This aligns with the discoveries reported by Marsh and Bugusu (2007) which concluded that adequate packaging plays a crucial role in safeguarding products from diverse contaminants, thereby prolonging the shelf life of the products. The sensory and shelf life quality that produced the best was recorded in Sample B which was smoked to the least moisture content and wrapped in a paper. Paper wraps allowed for the passage of air even though it became susceptive to insect infestation if not kept upright. Reports are given that polythene packaging is rated among the best packaging methods followed by Osibona et al. (2018) and Ozoh and Orji (2022) which negates the results of this research. The poor electricity and poor facilities present in our country inform not only easier ways of preservation but also cheaper and sustainable ways of maintaining the availability of food and nutrition. Based on the observations, the most superior smoked samples exhibited highly favourable quality attributes, including firm and juicy textured skin, a pleasant odour, and a reddish-brown colour. These qualities were particularly notable in samples that underwent a drying period of three (3) days and were wrapped with white paper. This contradicts the findings of Gopal and Shankar (2011), who asserted that the necessary attributes for proper storage and packaging of smoked fish encompass inertness, leak-proof qualities, impermeability to oxygen and moisture, low transparency, and resistance

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to abrasion and puncture. This may be attributed to the environment within the storage area in Alvan Ikoku Federal College of Education.

Conclusion

Fish food options have always been the priority of consumers because of the numerous benefits attributed to it, however, this commodity that is always in demand and needs to be readily available is very susceptible to spoilage and loss of form if a form of preservation is not readily employed. Results from this study have shown that these frozen imported fish which are highly perishable without immediate refrigeration can have their quality and taste preserved for over three weeks by smoking in a protected kiln for three days and wrapping in a white paper pack away from the reach of animal and insect pests as paper wraps kept longer than the polythene wraps.

Recommendation

It is therefore recommended that consumers buy and share frozen fish in bulk (directly from the wholesalers) to reduce cost and then preserve by smoke drying as the absence of electricity within Owerri metropolis is unavoidable. This will keep for a long with taste and microbial quality intact.

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