International Journal of scientific research and management (IJSRM)
||Volume||1||Issue||7 ||Pages|| 371-375||2013||
Website: www.ijsrm.in ISSN (e): 2321-3418

Effects of drying Temperatures on the Quality of Three Tilapia Fish Species

C. A. Komolafe[1], I. O. Oluwaleye[2], A.O.D. Adejumo[3], M.O. Oladapo[4]

[1] Mechanical Engineering Department, Landmark University, Omu- Aran, Kwara State, Nigeria.

[2] Mechanical Engineering department, Ekiti State University of Ado Ekiti, Nigeria.

[3] Federal College of Agriculture, Agricultural Engineering Programme, Ibadan, Nigeria.

[4] Central Lab. Services, Microbiology Laboratory, I.A.R&T Moor plantation, Ibadan,Nigeria.

Abstract
The effects of drying temperatures on the quality of three tilapia fish species were reported. The fresh fish samples obtained from local markets in Ibadan, Nigeria were dried in a convective fish dryer at 60°C , 90°/ 60°C (90°C at initial stage and later at 60°C) and 90°C drying temperatures. The average microbial load (Total viable bacteria, total coliform and total fungal counts) obtained from dried Mackerel, Pilchard and Herring for 8hrs duration ranged from 0.15 x 10^4 to 2.4 x10^4 Colonies per gram sample (cfug^{-1}). The Organoleptic analysis revealed that the attributes (flavour, texture and colour) of the three species dried at 90°/ 60°C were more appropriate and acceptable. The shelf – life obtained from the dried samples of Mackerel, Pilchard and Herring were 1, 2 and 2weeks; 2, 3 and 5 weeks and 1, 1 and 2 weeks at 60°C , 90°/ 60°C, 90°C drying temperatures respectively. The results therefore suggested 90°/ 60°C drying temperature for fish drying.

Keywords : Drying, Drying temperatures, Fish, Microbial, Quality, Tilapia.

I. INTRODUCTION

Fish is an important component of diet for people throughout the world, thus providing nutritional value security to the food basket and earning foreign currency. However , according to Ogbonaya (2009), the gap between the demand and supply of fish is widening due to increase in population, poor post harvest handling, lack of processing and storage facilities and utilization of unconventional fish species. Mayboom (1974), similarly reported that 15% of the total fish catch in Kainji Lake is lost because of spoilage and breakage between the sources of supply and the consumer.

Ogunleye (2006) observed that the use of appropriate methods of preservation creates the possibility of having greater increase in the amount of fish available for human consumption. The purpose of preservation is to reduce the moisture content of the fish because micro-organism that are responsible for spoilage and wastage cannot survive without moisture.

Some of the preservation methods/ techniques according to Peter and Ann(1992) include cooking (boiling and frying), salting, smoking and drying collectively known as curing (lowering the moisture content) and fermentation (lowering the pH). Traditionally, fish is dried on rack in an open air / sun or smoked on a raised smoking " Tables" or three-stone stove where control of heat is difficult and at times impossible. The result of which usually is unsatisfactory end products. However if acceptable and suitable drying temperature(s) are used, post harvest losses incurred as a result of under-drying and over-drying would be greatly reduced. Rahman (2006) reported 90^0C and 60^0C as maximum and minimum drying temperatures for fish. Also the results of British Food Investigation according to Jarvis (1987) advised a maximum drying temperature of 70^0C. The research thus studying the effects of three drying temperatures on the quality of three Tilapia fish species.

II. MATERIALS AND METHODS

A total of 90 fresh fishes, 30 each from the three tilapia species namely mackerel, (*Scomber scombus*), Pilchard (*Sadinella pilchardus*) and Herring (*Culpea harvengus*) were obtained from local markets at Ibadan, Nigeria. The fishes were dried batch wise at different temperatures on different days in a designed and locally fabricated convective fish dryer.

2.1 Drying Process

The fishes were initially washed thoroughly, clean of gills and entrails and pre-heated with salt. The pre-heated fishes arranged in a single layer were left to drain for five minutes in the already pre-weighed drying tray outside the drying cage and the chamber. The pre- heated fishes with known initial weight were then loaded with the tray inside the dryer already preset at required drying temperature 60°C being the lowest drying temperature reported by a renowned food drying expert Rahaman (2006) for the three species on separate days continuously for 8hrs. The same was repeated at a preset drying temperature 90°C / 60°C (90°C initially for two hours and 60°C later for six hours.) and 90°C (maximum recommended by Rahaman, 2006).

2.2 Microbiological Quality Test.

2.2.1 Microbial Load Count.

Microbial count tests which consist of total viable count, total coliform count and total fungal count of the three dried samples (mackerel, Pilchard and Herring) at different drying temperatures were carried out in duplicates. Fifty grammes sample of dried samples were blended with 450ml of sterile 0.1% peptone water as described in the Bacteriology Analytical material FDA, (1989). Pour plates were species dried at different drying chamber temperatures. From Table 1.(a) the average total viable bacteria counts of the dried samples at 60°C drying temperature were 1.3×10^4 , 0.7×10^4 and 1.5×10^4 $Cfug^{-1}$ for Mackerel, Pilchard and Herring respectively. Also, the average total coliform and fungal count at this same temperature were 0.5×10^4 and 0.7×10^4 , and 0.15×10^4 and 0.3×10^4 for Mackerel and herring only. No total coliform and fungal counts were recorded in pilchard.

The microorganisms isolates identified in the samples dried at 60°C include *Staphylococcus aureus, Bacillus cereus, Micrococcus accidiophilus, Bacillus subtilis Rhizopus nigricans and Aspergillus niger.*

Similarly, from Table 1.(b) the average total viable bacteria counts of the dried samples at 90/60°C drying temperature were 1.0×10^4 , 0.5×10^4 and 0.9×10^4 $Cfug^{-1}$ for Mackerel, Pilchard and Herring respectively. Also, the average total coliform count at 90/60°C drying temperature were 0.25×10^4 , 0.4×10^4 and 0.15×10^4 $Cfug^{-1}$. The average total fungal recorded was 0.25×10^4 for pilchard only. The microorganisms isolates identified in the samples dried prepared from 10 – fold dilutions in nutrient agar (oxoid) for total viable bacteria count and Mac Conkey agar (oxoid) for total coliform counts and Potato Dextrose agar (oxoid) for fungal counts were made after incubation at 37°C for 24hrs for bacteria and 72hrs for fungal. The isolates were identified with reference to (Cowan and Steel's manual, 1985).

2.2.2 Organoleptic Analysis

The sensory (organoleptic) analysis was also carried out on the dried samples under ten member "Tasting Panel" and scoring was done as follows: (Very Good) = 4, (Good) =3 and (Fair) = 2

2.2.3 Determination of Shelf life

The Shelf life of the dried fish samples was determined by wrapping each of the products from the three fish species in aluminum foil sheet and storing for 7weeks.The attributes and conditions of the stored products were assessed regularly at one week interval.

III. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Microbiological quality Test

3.1.1.1 Microbial Count

Table 1(a) to (c) shows the results of microbial load analysis carried out on each

at 90/60°C includes *Staphylococcus aureus, Bacilus cereus, Micrococcus accidiophilus, Bacillus subtilis and Salmonella sp.*

From Table 1.(c) the average total viable bacteria counts of the dried samples at 90°C drying temperature were 1.7×10^4 , 2.3×10^4 and 2.1×10^4 $Cfug^{-1}$ for Mackerel, Pilchard and Herring respectively. Also, the average total coliform and fungal count at same 90°C drying temperature were 1.1×10^4, 1.2×10^4 and 1.3×10^4 , and 0.3×10^4, 0.5×10^4 and 0.2×10^4 $Cfug^{-1}$ for Mackerel, Pilchard and herring respectively.

The microorganisms (isolates) identified in the samples dried at 90°C include *Staphylococcus aureus, Aspergillus niger. Bacillus cereus, Micrococcus accidiophilus, Bacillus subtilis , Rhizopus nigricans, Streptococcus sp, Vibro sp, Clostridium sp and Samonolla sp*

3.1.1.2 Organoleptic Analysis

The results of organoleptic analysis obtained are shown in Table 2 (a) to (c). The attributes (flavour, texture and colour) of the three species were appropriate and acceptable.

3.1.1.3 Determination of shelf life

During preservation, the three dried samples (Mackerel, Pilchard and Herring) at 60°C show good attributes such as flavour, colour and texture. Mackerel retained the attributes for 1week (7 days) while Pilchard and herring retained the attributes for two weeks (14days) .

Similarly, The fish samples dried at 90/60°C during preservation show good attributes such as flavour, colour and texture. These attributes were retained in the three samples (Mackerel, Pilchard and Herring) for 2weeks (14 days), 3weeks (21days) and 5weeks respectively.

Also the dried samples at 90°C during preservation shows good attributes such as flavour, colour and texture. The attributes were retained for 1week (7 days) in both Mackerel and Pilchard while that of Herring lasted for 2weeks (14 days).

Table 1. (a):Results of total viable, coliform and fungal test for dried Mackerel (A), Pilchard (B) and Herring (C)at 60°C

Sample code	TotalViable Count ($Cfug^{-1}$)	Total Coliform Count ($Cfug^{-1}$)	Total fungal Count ($Cfug^{-1}$)
A_1	1.4×10^4	0.6×10^4	0.2×10^4
A_2	1.2×10^4	0.4×10^4	0.1×10^4
X	1.3×10^4	0.5×10^4	0.15×10^4
B_1	0.6×10^4	Nil	Nil
B_2	0.8×10^4	Nil	Nil
X	0.7×10^4	Nil	Nil
C_1	1.2×10^4	0.8×10^4	0.4×10^4
C_2	0.8×10^4	0.6×10^4	0.2×10^4
X	1.0×10^4	0.7×10^4	0.3×10^4

A = Mackerel, B = Pilchard and C = Herring X = Average

Table 1.(b) : Results of total viable, coliform and fungal test for dried Mackerel, Pilchard and Herring at 90/60°C

Sample code	TotalViable Count ($Cfug^{-1}$)	Total Coliform Count ($Cfug^{-1}$)	Total fungal Count ($Cfug^{-1}$)
A_3	0.8×10^4	0.1×10^4	Nil
A_4	1.2×10^4	0.4×10^4	Nil
X	1.0×10^4	0.25×10^4	Nil
B_3	0.4×10^4	0.2×10^4	0.4×10^4
B_4	0.6×10^4	0.6×10^4	0.1×10^4
X	0.5×10^4	0.4×10^4	0.25×10^4
C_3	0.8×10^4	0.1×10^4	Nil
C_4	1.0×10^4	0.2×10^4	Nil
X	0.9×10^4	0.15×10^4	Nil

A = Mackerel, B = Pilchard and C = Herring X = Average

Table 1.(c) : Results of total viable, coliform and fungal test for dried Mackerel, Pilchard and Herring at 90°C

Sample code	TotalViable Count ($Cfug^{-1}$)	Total Coliform Count ($Cfug^{-1}$)	Total fungal Count ($Cfug^{-1}$)
A_3	1.6×10^4	1.2×10^4	0.4×10^4
A_4	1.8×10^4	1.0×10^4	0.2×10^4
X	1.7×10^4	1.1×10^4	0.3×10^4
B_3	2.2×10^4	1.4×10^4	0.6×10^4
B_4	2.4×10^4	1.0×10^4	0.4×10^4
X	2.3×10^4	1.4×10^4	0.5×10^4
C_3	2.2×10^4	1.4×10^4	0.1×10^4
C_4	2.0×10^4	1.2×10^4	0.2×10^4
X	2.1×10^4	1.3×10^4	0.2×10^4

A = Mackerel, B = Pilchard and C = Herring X = Average

\

Table 2. (a) : Results of Organoleptic analysis of fish species at 60°C

Attributes	Mackerel	Pilchard	Herring
Flavour	3	3	4
Texture	4	2	3
Colour	3	3	2
Average	3.3	2.6	3.0

Table 2. (b) : Results of Organoleptic analysis of fish species at 90/60°C

Attributes	Mackerel	Pilchard	Herring
Flavour	4	3	4
Texture	4	4	3
Colour	3	3	3
Average	3.6	3.3	3.3

Table 2. (c) : Results of Organoleptic analysis of fish species at 90°C

Attributes	Mackerel	Pilchard	Herring
Flavour	3	3	2
Texture	2	2	3
Colour	2	3	3
Average	2.6	2.6	2.6

3.2 Discussion

From tables 1.(a) to (c) it is revealed that the average microbial load (Total viable bacteria, total coliform and total fungal counts) for dried Mackerel, Pilchard and Herring for 8hrs ranged from 0.15 x 10^4 to 2.4 x10^4 Colonies per gram sample (cfug^{-1}) were within recommended microbiological limits of 10^3 to 10^4 Cfu/g reported by International Commission on Microbiological Specification for Foods (ICMSF) (1986) in good manufacturing practices.

x 10^5 respectively. Also Brian and et al.(1995) reported microbial count 2.1 x 10^6 and 2.8 x10^6 Cfu/g respectively for similar fishes smoked and sun-dried for four days. Although after each drying operation, the aroma and satisfactory attributes (flavour, texture and colour) that are known with drying of fish were detected and perceived. Averagely, the highest attributes of 3.6, 3.3 and 3.3 obtained from the organoleptic analysis of the dried products, suggested 90/60°C as the best drying temperature for fish drying . Also, the longest Shelf- life 2,3 and 5weeks obtained from the dried fish samples (Mackerel, Pilchard and Herring) suggested that out of the three drying temperatures, 90/60°C is most suitable for fish drying.

IV. CONCLUSION

The effects of drying temperatures on the quality of three tilapia fish species were reported.The average microbial load (Total viable bacteria, total coliform and total fungal counts) from dried Mackerel, Pilchard and Herring for 8hrs duration ranged from 0.15 x 10^4 to 2.4 x10^4 Colonies per gram sample (cfug^{-1}) were within the recommended microbiological limits of 10^3 to 10^4 S.aureus/g. The shelf – life obtained from the dried samples of Mackerel, Pilchard and Herring were 1, 2 and 2weeks; 2, 3 and 5 weeks and 1, 1 and 2 weeks at 60°C , 90°/ 60°C, 90°C drying temperatures respectively.

REFERENCES

[1] H.H. Brian, A.C. Charles , and C.P. Robert, Microbial Quality of an Alaska Native Smoked Salmon Process . Journal of food protection, vol. 59, July 1995, pp56 – 58.

[2] S,T.Cowan,"Cowan and Steel Manual for the identification of Medical Bacteria," CambridgeUniversity Press, London, 1985 , pp 331.

The low microbial count reported in the tested samples indicates that consumer of the fish products dried by this Convective fish dryer may not be at risk. Also comparing these microbial results with past research projects on fish drying by open sun, smoking and solar, the convective fish dryer has proved to be more efficient and effective. For instance, Ogunleye (2006), used the methods mentioned above for the same Tilapia species for four days and reported microbial counts 3.42 x 10^6 , 1.02 x 10^5 and 2.28

Food and Drug Administration, **"**National Shelfish Sanitation Program" Manual of Operations, part II, sanitation of the Harvesting, Processing and Distribution of Shelfish. Pubic Health Service, Shelfish sanitation branch, Washington DC.1989.

[3] International Commission on Microbiological Specifications for foods (ICMSF), "Sampling Plans for fish and Shellfish.pp. In Microorganism in foods 2 . Sampling for microbiological analysis" Principles and specific applications, 2nd ed. University of Toronto Press, Toronto. 1986 ,181 – 196.

[4] J. Mayboom , "Fish Handling and processing in the Kainji Lake Basin and suggestions for improvement and future research Kainji Lake Research Institute, New Bussa.Nigeria," Vol.9 (1), African Journal of Biotechnology, Jan.2010,pp.073-076.

[5] C.Ogbonnaya , "Influence of Drying Methods on Nutritional Properties of Tilapia Fish *(Oreochromis nilotieus)*," World Journal of Agricultural Sciences, 5(2): IDOSI Publications 2009, ISSN 1817-3047, 256-288.

[6] I.O. Ogunleye, **"**Preservation of fish through Solar drying," Journal of Science and Technology Research, Vol. 5 No3, ISSN 1596- 9649, 2006. Pp.15

[7] F. Peter, and H . Ann, "Small scale food processing," Intermediate Technology Publication, 103 – 105 Southampton Row, London WciB4HH, Uk. 1992 , Pp60-64.

[8] M.S. Rahman, "Drying of fish and Seafood," In Handbook of Industrial Drying, Ed; Mujumdar, A.S. Ed. Taylor and Francis Group LLC Part II Ch.22 2006, pp.573 - 587.