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Full Length Research Paper

Proximate composition and quality aspects of iced wild and pond-raised African catfish (*Clarias gariepinus*)

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Proximate composition and shelf-life studies of wild and pond-raised catfish (*Clarias gariepinus*) were determined using chemical, microbiological and sensory analyses. Proximate composition of both wild and pond-raised catfish showed differences in the lipid and protein levels. The pond-raised fish had higher lipid (6.30%) and protein (20.00%) than the wild fish lipid (4.48%) and protein (18.05%). Whole ungutted wild and pond-raised catfish was in good and satisfactory conditions for 17 and 22 days, respectively when stored in ice immediately after harvesting. There was no significant difference ($p > 0.05$) in the storage life in ice of the wild and pond-raised catfish. The descriptive sensory evaluation showed that the fish underwent changes in eyes, gills, texture, odour and general appearance. The statistical analysis showed that the correlations between the cooked odour, texture and flavour of both samples were significant at $p < 0.05$. The wild and pond-raised catfish showed a decline in sensory parameters during storage in ice with concomitant increase in bacteria counts and total volatile bases (TVB). The microbial population was dominated by bacilli, the counts ranged from 11.5×10^2 cfu/g to 15.4×10^2 cfu/g for wild catfish and 9.7×10^2 cfu/g to 11.1×10^2 cfu/g for the pond-raised catfish. Rejection of the catfish after 22 days was based mainly on rancid, putrid, fecal, ammoniacal and sulphide odours. TVB ranged from 2.41 to 20.50 mg/100 g for wild catfish and 2.86 to 22.88 mg/100 g for pond-raised catfish.

Key words: Sensory changes, farmed *Clarias*, wild *Clarias*, shelf-life.

INTRODUCTION

Fish is one of the most valuable sources of high protein in Nigeria and catfish in particular is one of resource of economic importance in the small-scale fishery subsector and knowledge of its composition during storage is essential if the fullest use is to be made of it. Effiong and

Fakunle (2011) studied the proximate composition of *Clarias gariepinus*, *Oreochromis niloticus*, *Bagrus bayad* and *Citharinus citharus* and reported that their protein content ranged from 21.62 to 60.57%, ether extract was 3.88 to 9.1%, while ash and crude fiber were 1.35 to

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5.88% and 0.37 to 1.5%, respectively. Proximate composition of the Moonfish revealed that it contained 77.1% moisture, 0.98% lipid, 20.4% crude protein and 1.5% ash (Adejonwo et al., 2010). Proximate composition of some fresh water fishes from Ikosi Dam, Ogbomoso, Nigeria was reported by Adeyeye and Ayoola (2010). They observed that moisture content ranged from 53.80 to 61.27%, 22.45 to 24.45%, 3.65 to 5.65% and 8.14 to 14.70%; also crude protein for each specie was as follows: *Tilapia zilli* 24.5%, 24.3% in *Channa obscura*, 23.4% in *Mormyrus rume* and 23.4% in *Malapterurus electricus*. Fat contents gave the second highest best concentrations in dry matter for all fish species analyzed. The ash and fiber contents were in much lower quantities. Fat content was highest in *C. obscura* (5.6%) followed by their contents in *C. gariepinus*, *T. zilli*, *M. electricus*, while the least composition was recorded in *M. rume*. Olele (2012) studied the nutrient composition of *Gnathonemus damandua*, *Chrysichtys nigrodigitatus* and *Auchenoglanis biscutatus* caught from River Niger. He observed that moisture content, crude protein, ether extract and ash data ranged as follows: 7.07 to 11.14%, 6.32 to 16.31%, 25.04 to 35.07% and 6.26 to 26.26%, respectively.

Catfishes of the family Claridae comprise the most commonly cultivated fishes in Nigeria. The growth of aquaculture in Nigeria now is largely being boosted by a steady rise in catfish culture. Since the culture of *C. gariepinus* through hypophysation was initiated in Western Nigeria in 1973, the procedure has been widely practiced throughout Nigeria thus leading to increase of farmed catfishes from the 80's to date (Adewumi, 2009). This study examines the proximate and organoleptic changes in wild and farmed *C. gariepinus* stored in ice.

MATERIALS AND METHODS

Sample collection and treatment

Live samples of wild catfish (*C. gariepinus*) of average weight between 200 ± 5.50 and 500 ± 5.0 g were purchased from commercial market in Ibadan, while farmed catfish were purchased from a commercial fish farm in Ibadan. The live fish samples were transported in plastic bucket containing water (26°C) to the Department of Wildlife and Fisheries Management Laboratory where the experiment was carried out. The fish were iced immediately and ice was maintained at the ratio 1:1 throughout the experiment. Ice was used to kill the fish. The fish were then washed and arranged in basket with ice at ratio 1:1 before they were kept in an insulated box (4 to 5°C). Every morning the melted water was drained away from the insulated box. The first sample was taken for analysis on the first day of the experiment. Subsequent samples were taken at 3 days interval for a period of 24 days.

Sample preparation

On each sampling day a total of 24 fish samples were removed

from the insulated box, washed, placed in trays on a table and assessed for freshness by the panelist. Fillets of each sample were also cooked for freshness assessment by the panelist. For microbiological and biochemical tests, fish samples were eviscerated, washed with distilled water and filleted with skin for analysis.

Proximate analysis

The proximate analysis of the fish samples were determined (AOAC, 1990) initially at the start of the experiment and finally at the end of the experiment. The analysis was done in duplicate and mean of the results recorded.

Chemical analysis

The total volatile base (TVB) was determined by the method recommended by the Analytical Methods Committee (AMC, 1979) which was based on a semi-micro distillation procedure.

Microbiological analysis

The counts of aerobic microorganisms in *C. gariepinus* stored in ice were determined according to the conventional Aerobic Plate Count (APC) method of AOAC (1990).

Sensory analyses

Attributes of raw fish

Six people comprising of both staff and students of the Department of Wildlife and Fisheries Management were used for quality evaluation using the Hedonic scale. Four whole fish samples that have been washed were given to each panelist for assessment. The fish were examined for changes in general appearance. This included describing the eyes, surface slime on skin, odour and colour of gills and texture. The score card used for the assessment is presented in Table 1. The maximum acceptable level is 9 (excellent) and minimum acceptable level is 6 (satisfactory).

Attributes of cooked fish

Fillets were cut from the four fish samples. The samples were steamed for 15 min in a water bath, placed in individual dishes, and presented to the panelists. The score card used for the assessment of cooked fish is presented in Table 2. The maximum acceptable level is 5 (Excellent) and minimum acceptable level is 3 (Good).

RESULTS

Proximate composition

The initial and final proximate composition of wild and pond-raised (*C. gariepinus*) is presented in Table 3.

Sensory assessment

The mean sensory scores of six panelists for whole fresh

Table 1. Score card for fresh *C. gariepinus*.

Score	Eyes	Gills	Skin	Texture
9 (Excellent)	Flat, transparent or slightly grey pupil	Red or rose coloured. Transparent mucus	Bright, iridescent very dark and clear colour	Flesh is firm and springs back immediately when released
8 (Very Good)	Very slightly sunken	Dark-red, yellowish mucus	Bright, dark colours	Reasonably firm, thumb indentation slowly fills out
7 (Good)	Slightly sunken, cloudy	Red-brown, mucus slightly opaque, gill-like colour	Some loss of brightness	Moderately firm
6 (Satisfactory)	Sunken, cloudy	Brown, mucus slightly opaque	Dull colours	Very slightly soft flesh skin coming up
5 (Poor)	Sunken, very cloudy	Brown, abundant harel-colour mucus	Dull colours	Very slightly soft flesh skin coming up
4 (Very poor)	Sunken, opaque	Sour sink, brown-grey very rich mucus	Dull, slightly opaque	Soft flesh
3 (Unsatisfactory)	Swollen, opaque	Brown-black or discoloured with thick brown-yellow mucus	Yellow slime on head and body	Excessive soft flesh

Table 2. Score card for assessing cooked *C. gariepinus*.

Score	Odour	Flavour	Texture
5 (Excellent)	Roast meat stewy	Sweat, creamy fishy	Moist, soft
4 (Very Good)	Slightly meat stewy	Slightly creamy fishy	Moist
3 (Good)	Neutral, sweaty	Slightly stale oil, neutral	Moist
2 (Poor)	Rancid	Slightly sour	Dry, sticky soft
1 (Unacceptable)	Rotten	Very sour	Dry mushy

Table 3. Mean proximate composition of *C. gariepinus*.

Parameter (%)	Wild <i>C. gariepinus</i>		Pond-raised <i>C. gariepinus</i>	
	Initial	Final	Initial	Final
Moisture	65.80	62.00	71.00	69.00
Protein	18.05	17.10	19.00	20.00
Lipid	4.48	5.20	6.30	7.20
Ash	2.60	2.30	1.20	1.80
Crude fiber	9.07	13.40	3.00	2.50

wild and pond-raised (*C. gariepinus*) stored in ice is presented in Table 4.

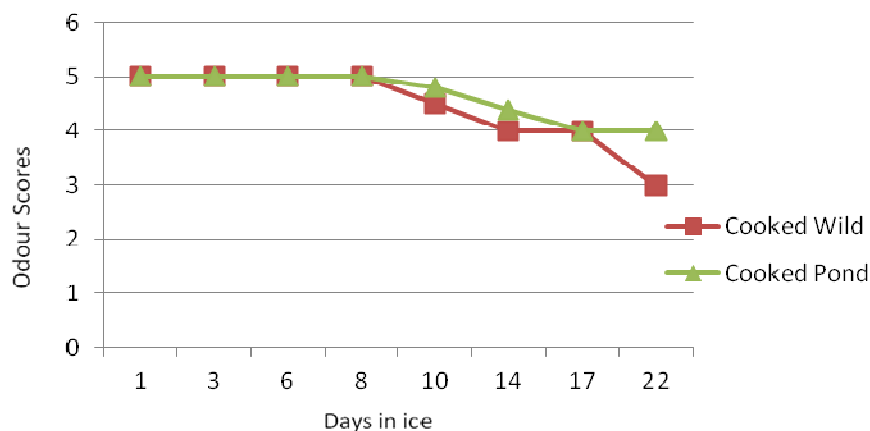
The results (for both wild and pond-raised fish) showed that fish iced at first day of experiment displayed all the characteristics of freshly caught fish with a score of 9.0.

The eyes were transparent, gills red coloured, and skin very dark with some mucus and texture of flesh was firm and elastic. The same attributes for first day were also noticeable on Day 3 in ice with a mean score of 9.0. However, there was a noticeable decrease in the attributes

Table 4. Panelist mean sensory scores for whole fresh *C. gariepinus* stored in ice.

Days in ice	Fresh wild <i>Clarias</i>				Fresh pond-raised <i>Clarias</i>			
	Eyes	Gill	Texture	General appearance	Eyes	Gill	Texture	General appearance
1	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
3	8.8	9.0	9.0	8.5	9.0	9.0	9.0	9.0
6	8.5	8.8	8.4	8.0	8.7	8.8	8.5	8.0
8	8.0	8.5	8.0	7.9	7.6	8.5	7.0	7.8
10	7.0	8.0	7.5	7.5	7.0	7.5	7.0	7.5
14	7.0	8.0	7.5	7.5	6.5	7.0	7.0	7.0
17	6.5	7.5	6.0	6.5	6.0	6.5	6.0	6.0
22	6.0	6.5	6.0	6.0	5.0	5.0	5.5	6.0

Source: Field Survey.

**Figure 1.** Changes in cooked odour of *C. gariepinus* stored in ice.

from Day 10. The eyes were sunken, the gills were red-brown with mucus, the skin lost some brightness and texture became moderately firm. The overall general appearance on Day 10 has a mean score of 7.5. An average score 6.0 was recorded on Day 17 which made fish fairly acceptable. The eyes were sunken and cloudy, the gills were brown and the flesh was slightly soft.

The mean sensory scores for cooked flavour, cooked odour and cooked texture of *C. gariepinus* (wild and pond-raised fish) are presented in Figures 1, 2 and 3. Note that each result is a mean of six taste panelists response on a scale where 5 = excellent, 4 = very good, 3 = good; 2 = poor and 1 = unacceptable.

The results showed that *Clarias* (wild and pond-raised fish) in ice for about 6 days has flavour characteristics of the species and a very strong meaty odour with a score of 5.0. On Day 8 there was a decline in the odour, flavour and texture of both samples. The minimum scores for wild *Clarias* at the end of the experiment was 3.0 which means that the fish sample was fairly acceptable.

However, the minimum for cooked pond-raised *Clarias* were 4.0 and 3.5 for odour, flavour and texture, respectively. The changes in cooked odour, flavour and texture scores with storage time are presented in Figures 1, 2 and 3, respectively. The correlation coefficient "r" for cooked odour, flavour and texture were 0.95, 0.94 and 0.97, respectively.

Chemical analysis

The results of TVB of wild and pond-raised *C. gariepinus* stored in ice are presented in Figure 4.

Microbiological analysis

Changes in aerobic plate counts and spoilage organisms isolated from wild and pond-raised *C. gariepinus* are presented in Table 5.

The result showed that the total viable count of wild and

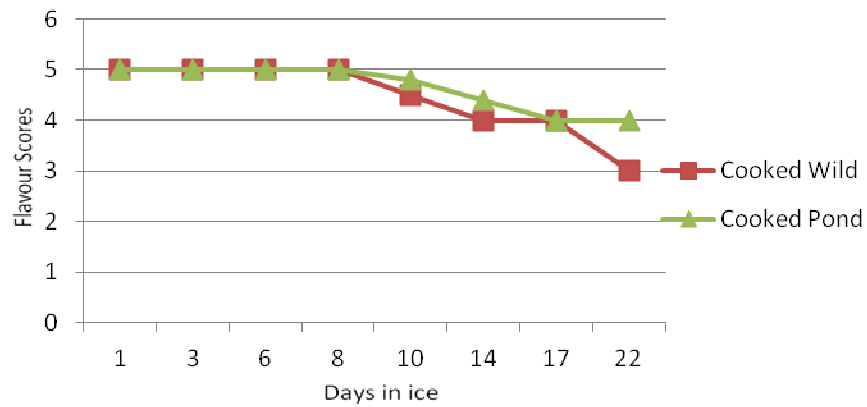


Figure 2. Changes in cooked flavour of *C. gariepinus* stored in ice.

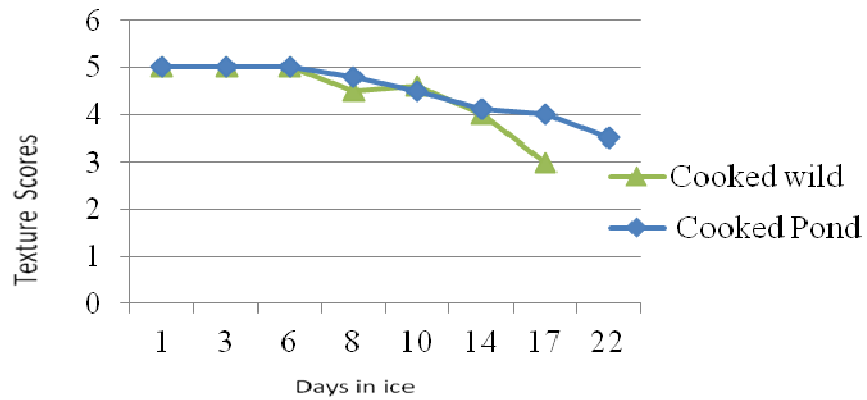


Figure 3. Changes in texture of cooked *C. gariepinus* stored in ice.

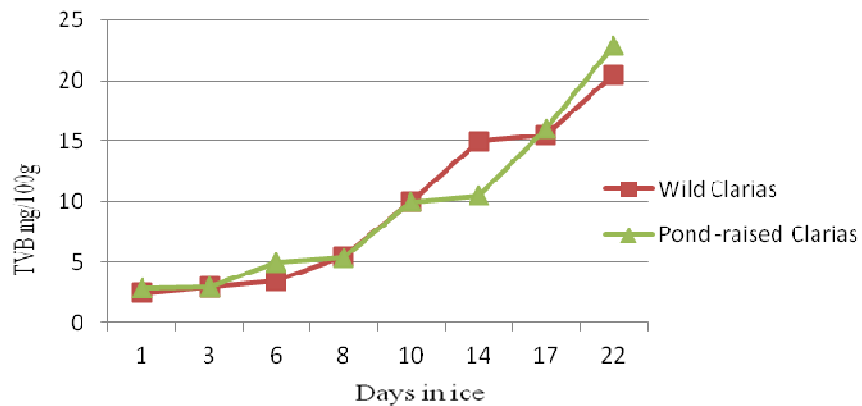


Figure 4. Changes in TVB of wild and pond-raised *C. gariepinus* stored in ice.

pond-raised *C. gariepinus* stored in ice did not exceed 10^6 cfu/g. The microbial population was dominated by

bacilli; the counts ranged from 11.5×10^2 cfu/g to 15.4×10^2 cfu/g for wild *Clarias* and 9.7×10^2 cfu/g to 12.8×10^2

Table 5. Microbiological analysis of *C. gariepinus* stored in ice.

	Wild <i>Clarias</i>			Pond-raised <i>Clarias</i>		
	Aerobic count (cfu/g)	Dominating organism	(cfu/g)	Aerobic count (cfu/g)	Dominating organism	(cfu/g)
Initial	2.3×10^5	Bacilli	11.5×10^2	2.5×10^5	Bacilli	9.7×10^2
Final	2.9×10^5	Bacilli	15.4×10^2	2.7×10^5	Bacilli	12.8×10^2

cfu/g for pond-raised *Clarias*.

DISCUSSION

Fish, which is a highly proteinous food is consumed by many because of its availability, flavour and palatability. *C. gariepinus* raised in the pond showed variation in nutrient composition. Moisture content was highest in cultured fish (71.00%) than fish obtained from the wild (62.00%).

The differences observed in the proximate composition of wild and pond-raised *Clarias* can be attributed to the supplementary diets given to the pond-raised *Clarias*. They are fed with feeds rich in protein (35 to 45% crude protein) which helped them to build their tissues. There is an inverse relationship between the moisture content and the lipid content both at the initial and final stages for the two samples.

The descriptive sensory evaluation showed that the fish underwent changes in the eyes, gills, texture and overall appearance can be deduced from the results that quality did not change significantly during the first 8 days. Based on the sensory scores, fresh *Clarias* samples kept very well in ice and in good condition up to Day 17. Using the Hedonic scale of 5.0 and below as the limit of unacceptability the shelf-life of *C. gariepinus* in ice was 22 days when we consider the general appearance. There is no significant difference ($P > 0.05$) in the storage life of the wild and pond-raised *Clarias*. This may be due to the fact that the two samples were subjected to the same storage conditions and according to Lucas and Ward (1996) postharvest handling is very important in extending the shelf-life of fish whether it is caught from the wild or raised in the farm.

All sensory attributes of cooked samples of *Clarias* which include flavour, odour and texture gave significant correlation with storage time ($p < 0.05$). The strong correlation of cooked flavour, odour and texture scores against storage time is an indication of the sustainability of visual and organoleptic changes as quality indices in *C. gariepinus*.

Using the Hedonic scale of 5 and 3 as the limit of unacceptability for the cooked odour, flavour and texture scores, the shelf-life of wild *C. gariepinus* was 20 days and shelf-life of pond-raised *C. gariepinus* was 22 days.

TVB nitrogen is a chemical test commonly carried out on freshwater fishes. A limit of 20 to 30 mg/100 g was suggested by Pearson (1982) when TVB is used as an index of spoilage for freshwater fish which means that the results obtained during the experiment fall within the limit. However, further work is required to establish standard rejection values of TVB that could be applied to *C. gariepinus*.

Microbiological activity is the main factor limiting the shelf-life of fresh fish; however, at 0°C freshness of fish is lost before bacterial counts increase significantly.

Conclusion

The shelf-life of *C. gariepinus* was found to be 22 days in ice for both wild and pond-raised fish. The postmortem quality changes by both endogenous and microbial deterioration processes could be controlled during storage in ice to some extent. The long shelf-life of *C. gariepinus* is of commercial importance. Fish caught close to population centers where only few days of storage is necessary before marketing need not necessarily be maintained at 0°C.

The TVB used as index of quality for freshwater fish increased with storage time. The experimental data suggested that microbial activity was not only responsible for the increase in TVB content. The biochemical changes brought about by enzyme activities in the tissue can also be responsible for the increase in TVB during the storage period.

The results of this study could help fish farmers and processors to observe more adequate post catch handling practices in freshwater fish species particularly catfish and to establish processing procedures to develop and consolidate this important fishery with an export potential.

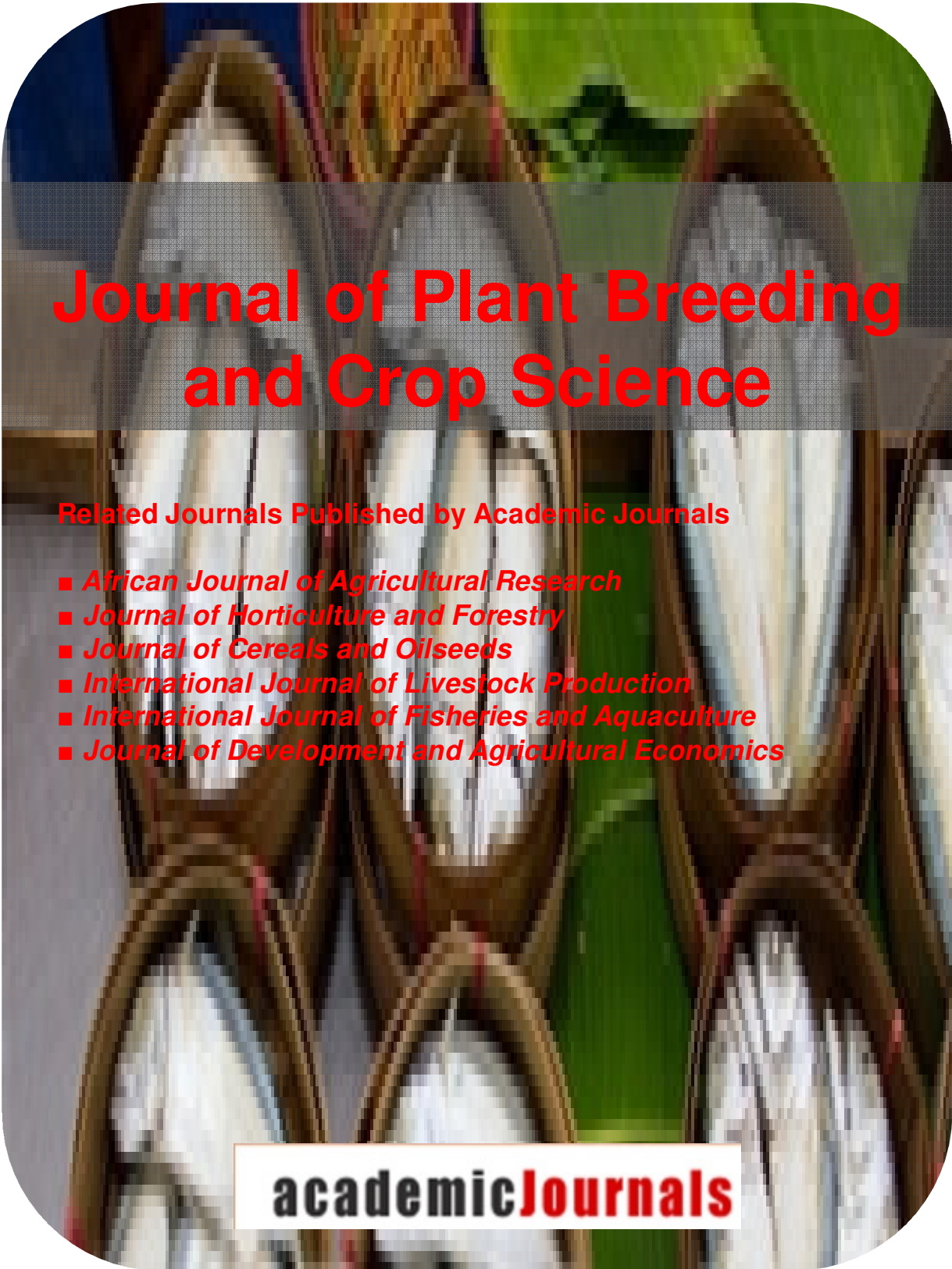
Conflict of Interests

The author(s) have not declared any conflict of interests.

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