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Toxic and Potentially Toxic Constituents of Gari and Beef Marketed in Nigerian Traditional Markets

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In many developing countries, the internal food supplies emanate from two principal sources: the largely illiterate food processors who use traditonal methods of processing and marketing, and the modern usually educated food processors, who use modern and scientific methods.

Unlike their modern counterparts, the traditional food processors' operations, usually, are not subjected to close regulatory scrutiny. This leaves room for the production and marketing of potentially unsafe foods.

Therefore, two Nigerian foods (gari - flour from Manihot, and beef) processed and marketed using Nigerian traditional methods, have been analyzed in the present studies for some toxic and potentially toxic constituents shown in the Tables of results. There appears to be limited or no reports on the toxicological aspects of both foods examined in the studies.

MATERIALS AND METHODS

Yellow and white gari samples produced by using Nigerian traditional methods, and beef (from the thigh of a cow) were purchased at different traditional markets in Benin City, Nigeria. These were designated locationally as A, B, C, D and E, respectively.

Duplicate samples (250 g, each) of each of the beef samples were stored in 3 separate 500-ml glass beakers, for 24 h at ambient conditions ($25 \pm 2^{o}C$, day temp.; $15 \pm 3^{o}C$, night temp).

The nitrate and nitrite contents were determined (Pearson 1976). Moisture determination was by the AOAC (1970) method. Qualitative screening for aflatoxin was in accordance with the Uraih and Ogbadu (1980) me-

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thod. For sand content determination, 100ml distilled water was added, with shaking, to 10 g red gari, in a 500-ml glass beaker which was later centrifuged for 25 min at 10,000 g in an HR-1, IEC centrifuge. The sand particles were recovered at the bottom by careful decantation of the upper layers of gari and water. The recovered sand particles were dried at 100°C in an oven and sand cotent expressed as percentage of the original wt. of gari sample.

Foreign matter, exclusive of sand, was quantified by manually collecting all such matter from 10g gari sample, weighing the pooled collections and expressing the results as percentages of the original wt. of sample.

The total plate counts of the gari and beef samples were determined by standard methods (Frazier et al. 1968).

RESULTS AND DISCUSSION

The nitrate contents of all the white gari samples examined in these studies were markedly lower than the corresponding values for the yellow type (Table 1).

Table 1. Nitrate and nitrite contents (averages of duplicate determinations) of gari marketed in Nigerian traditional markets.

Source and type of gari	NO_3^- content (µg/g)	NO_2^- content (µg/g)
AY = Yellow gari, market A	29.4	8.8
AW = White gari, market A	16.8	7.5
BY = Yellow gari, market B	39.8	11.3
BW = White gari, market B	17.9	10.0
CY = Yellow gari, market C	23.1	12.5
CW = White gari, market C	19.9	6.3
DY = Yellow gari, market D	27.3	12.5
DW = White gari, market D	14.7	8.8

This was probably because of the greater susceptibility of the white gari to attack by nitrate - degrading microbes. Possibly, the added oil was a source of additional nitrate in the yellow gari. The higher nitrite contents of the various yellow gari samples than those of the white type could also be due to this, since nitrates are precursors of nitrites in foods.

The levels of nitrates and nitrites presented in Table 1 are much lower than those reported for canned baby food. They are also much lower than the 200 mg/kg nitrite and 500 mg/kg nitrate allowed in pickled meat, bacon and ham (Pearson 1976). The marked differences in the respective levels of nitrates and nitrites detected in the gari samples, even among samples of the same type (i.e, yellow or white) are reflective of unstandardized processing and storage techniques by the traditional food processors in Nigeria, varietal and agronomic differences and differential rates of uptakes from the soil by the cassava roots from which the various gari samples were prepared.

An inverse relationship between the nitrate and nitrite contents of stored beef is observable in Table 2. This suggests conversion of nitrate to nitrite in the route of carcinogenic nitrosamine formation from nitrates (Mirvish 1975).

Table 2. Nitrate and nitrite contents (averages of duplicate determinations) of fresh and stored beef marketed in Nigerian traditional markets

Source	Nitrate content (µg/g)		Nitrite content (µg/g)	
	Fresh beef	Stored beef (24 h)	Fresh beef	Stored beef (24 h)
A	36.8	3.7	8.8	18.8
B	12.6	6.8	6.3	12.5
C	17.9	8.4	10.0	16.3
D	14.7	12.6	6.2	12.5
E	22.1	4.7	11.3	25.0

The conversion of nitrate to nitrite might be a purely chemical process involving reducing agents such as H_2S, SO_2, sulfhydryl compounds present in the atmosphere and food, or it might involve nitrate - reducing microbes, as was likely in the stored beef whose plate count increased markedly (Table 3).

The levels of nitrates and nitrites reported for the fresh and stored beef in Table 2 are much lower than the permitted levels in meat and meat products (Pearson 1976) apparently because, traditionally, meats are not fortified with these potentially toxic but, nevertheless, important food additives, in Nigeria. This is probably true of other developing countries.

A high level of moisture in foods can promote the development of undesirable bacteria, yeast, mold and toxins (Pitt 1975). The levels of moisture in the beef are, therefore, consonant with the plate counts shown in Table 3.

However, that the yellow gari with a moisture content of 16.0% had a lower plate count than the white gari which had a moisture content of 8%, suggests that moisture may not be the sole determinant of microbial infection of gari.

Table 3. Some toxicological parameters of beef and gari marketed in Nigerian traditional markets.

Parameter	Sample	Amount (Averages of, at least, duplicate values)
Moisture	Fresh beef	78.4%
	Yellow gari	16.0%
	White gari	8.6%
Sand	Red gari	0.02 - 0.03%
Foreign matter	Red gari	0.03 - 0.06%
Plate count	Fresh beef	79×10^4/g
	Stored beef (24 h)	289×10^4/g
	Yellow gari	26×10^4/g
	White gari	45×10^2/g
Aflatoxin	Fresh and stored beef	Not detected
	Yellow gari	"
	White gari	"

Direct transfer of microbes during haggling and delivery in the markets, may also be important.

The higher moisture content of the yellow gari probably can be ascribed to its greater surface hydrophobicity and therefore greater moisture retention within the gari grains.

The generally high plate counts of the beef and gari samples and the presence of sand and foreign matter, some levels of which may be toxic, call for greater sanitation in the traditional methods of food processing, storage and marketing.

In view of the carcinogenicity of aflatoxins (Wogan 1976; Howarth and Wyatt 1976), it is desirable that none was detected in the beef and gari samples examined in these studies.

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