Cyanide concentration in fried cassava chips and its effect on chip taste

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Abstract

Fried chips prepared from cassava tuber or flour are consumed as snack in some Asian countries such as India, Indonesia, Malaysia and the Philippines. Chips made from fresh tubers were similar to potato chips and contained safe levels of cyanide, if low-cyanide varieties were used. Those processed from flour, often called *Kroepeck*, also contained minimal cyanide if the flour was obtained from low-cyanide clones. The colour and taste of *Kroepeck* also depended on the cassava variety.

Introduction

Cassava (Manihot esculenta Crantz) is utilized mainly as a staple food in Africa. It is also consumed as a snack in the form of chips made from either the fresh tubers or the flour in some Asian countries such as India, Indonesia, Nalaysia and the Philippines.

Fried chips are also prepared from Irish potato (1), sweet potato (2), yam (3), cocoyam (4) and plantain. In addition, milled rice flour is used in the production of a puffed-rice snack in the Philippines called Kroepeck (5). In Indonesia and Malaysia, chips made from cassava flour or starch are also called Kroepeck or Krupuk (6). Among these materials which are processed into chips, only cassava may contain toxic levels of cyanide. This study was, therefore, conducted to determine whether processing cassava fresh tuber or cassava flour into fried chips reduces HCN concentration to safe levels, and the effect of HCN on chip taste.

Materials and Methods

Preparation of Cassava Flour

Cassava tubers from 37 clones (Table 1) were washed, peeled, cut into thin chips, dried at 55°C and ground in a Wiley mill.

Preparation of Chips

Chips from fresh tubers of TMS 30001 and TMS 4(2)1425 were prepared according to Fig. 1. Flour from the 37 clones (Table 1) were made into chips using the procedure outlined in Fig. 2.

Table 1: IITA improved cassava clones prepared into flour and fried chips.

TMS 518	TMS 50207	TMS 84537
TMS 1525	TMS 50395	TMS 84751
TMS 30001	TMS 60142	TMS 90205
TMS 30040	TMS 60447	TMS 90257
TMS 30211	TMS 60506	TMS 91142
TMS 30337	TMS 61677	TMS 91934
TMS 30474	TMS 63397	TMS 4(2)0156
TMS 30555	TMS 71173	TMS 4(2)0267
TMS 30752	TMS 8010	TMS 4(2)0378
TMS 40081	TMS 8034	TMS 4(2)0780
TMS 40160	TMS 8042	TMS 4(2)1425
TMS 42025	TMS 84261	TMS 4(2)1443

^aA local cultivar.

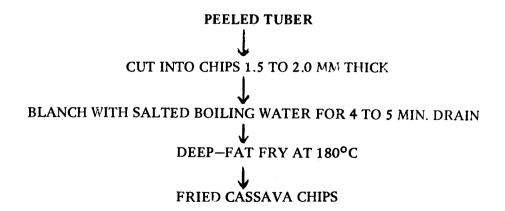


Fig. 1: Preparation of Cassava Fresh Tuber into Fried Chips

CASSAVA FLOUR (100 G)

MIX WITH 2 G NACL (TABLE SALT) + 80 ML WATER AND FORM INTO A DOUGH ROLL

STRAIN FOR 60 MIN. IN AUTOMATIC RICE COOKER

DRY FOR AT LEAST 5 HR. AT ROOM TEMP

CUT INTO 1.5 MM TO 2.0 MM THICK CHIPS

DRY AT 55°C FOR 3 HR.

DEEP-FAT FRY AT 180°C UNITL CHIPS FLOAT AND ARE COMPLETELY PUFFED

FRIED CHIPS (KROEPECK)

Fig. 2: Processing of Cassava Flour into Chips.

Cyanide Analysis

Total cyanide (released HCN and cyanoglucosides) content of cassava tuber, flour, raw and fried chips were extracted with $0.1~N~H_3PO_4$ and analyzed by the automated enzymatic chloramin T – pyrazolone method (7,8).

Results and Discussion

Changes in Cyanide Concentration during Preparation of Chips

Reduction in cyanide concentration during processing of cassava tubers into traditional African foods such as gari, fufu, chickwange, etc. had been reported (9, 10, 11). Most of the preparative methods used decreased concentrations to levels that are considered innocuous or safe.

As a guide for cyanide toxicity in the peeled fresh tuber, the following may be adopted. Less than 5 mg HCN/100 g is considered innocuous, 5–10 mg HCN/100 g is moderately poisonous, and more than 10 mg HCN/100 g is dangerously poisonous (12). For gari, 3.0 mg HCN/100 g was regarded safe by Akinrele (13) but a lower limit of 2.0 mg HCN/100 g is the recommended concentration by the Standards Organization of Nigeria (14). Suggested limits for other cassava products, including fried chips, are not available.

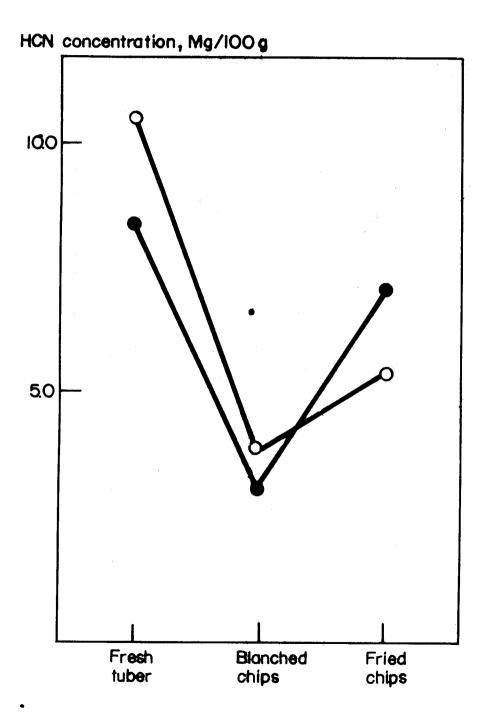
Changes in cyanide concentration during production of chips from fresh tubers for two cassava clones are given in Fig. 3. Blanching the chips in salted boiling water for 4 to 5 min caused 63.7% and 64.2% reduction in TMS 30001 and TMS 4(2)1425 respectively. Boiling fresh tuberous roots until cooked, usually for a period of 20 to 30 min depending on the cut tuber size, decreased cyanide slightly more to 70% (10).

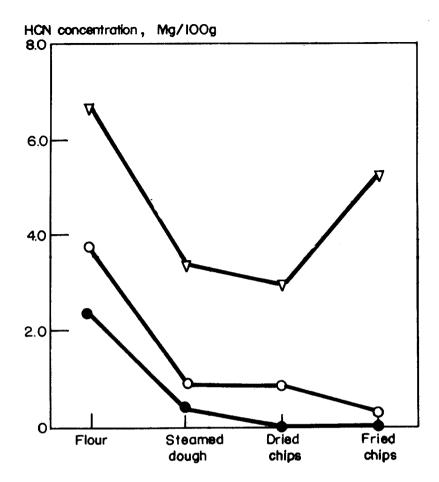
Removal of water during frying increased the apparent cyanide concentration. Oven- or sun-drying of ¼" thick chips increased dry matter of the tuber from 30% to at least 90% (10). Assuming that frying also decreased chip moisture to 10% only, further reduction to a total of 72% for TMS 30001 and to 83% for TMS 4(2) 1425 actually occurred. To produce fried chips with safe cyanide levels from fresh tubers, low—cyanide clones or varieties are required due to the low final values for cyanide reduction.

More steps were involved in the preparation of fried chips from cassava flour. Cassava flour appears to have higher cyanide concentration when newly prepared. Initial values in mg HCN/100 g for the clones used in Fig. 4 were 5.9 for TMS 4(2)1425, 21.8 for TMS 30572 and 40.6 for TMS 50395 (15). Storage reduced these to 2.4, 3.8 and 6.7 mg HCN/100 g, respectively. A study on changes in flour cyanide content of different cassava clones during storage is in progress for verification.

Most of the cyanide was removed during steaming. Fried chips of TMS 30572 and TMS 4(2)1425 had minimal concentrations; 0.3 and 0.04 mg HCN/100 g, respectively. However, cyanide concentration in TMS 50395 apparently increased to 5.3 mg/100 g due to the elimination of more water in the dried chips during frying without a simultaneous increase in the release of free cyanide. Previous heat treatment had already inactivated the enzyme lina-

marase and only the trapped HCN was removed by frying. It appears that preparing fried chips from flour results in a product that contains minimal cyanide concentration if low-cyanide flour is used.

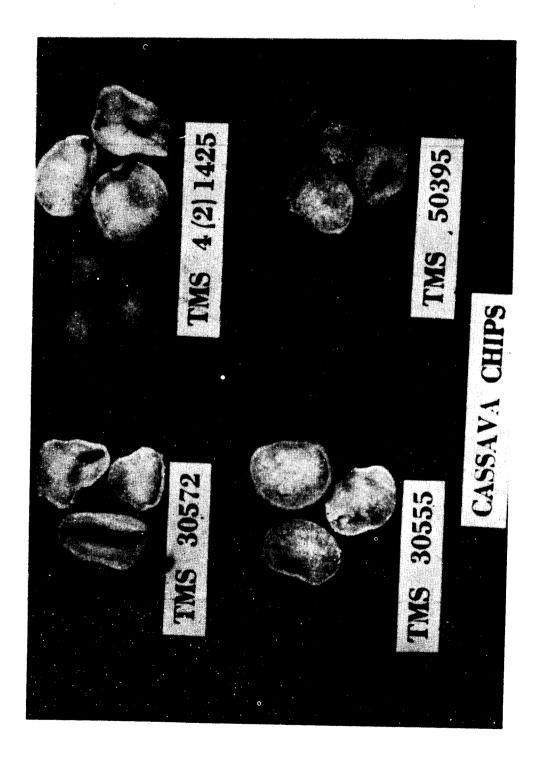


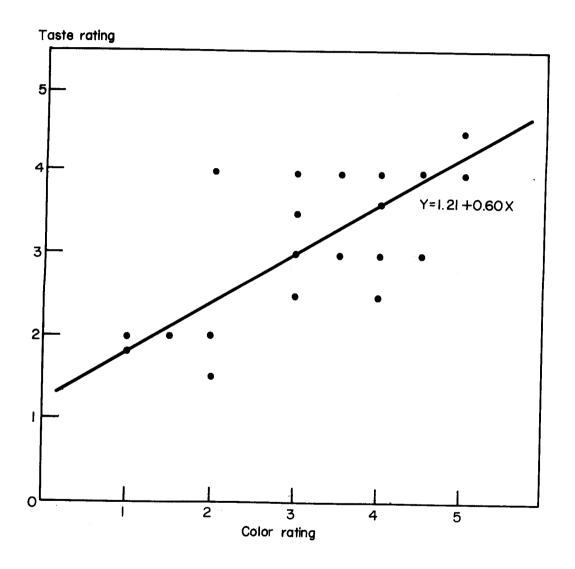


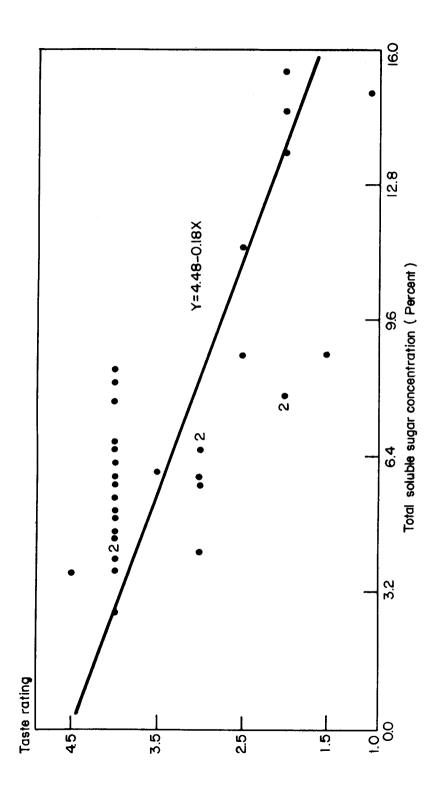
3.2 Factors Affecting Taste of Flour Chips

Fried chips from flour were rated for colour and taste on a scale of 1 to 5 where 1=dark brown and 5 = light brown (colour); and 1= slightly bitter and 5= slightly sweet (taste). Colour of both the dried and fried chips varied depending on the cassava clone. Among the four clones shown in Fig. 5, TMS 4(2)1425 was the lightest colored, followed by TMS 30572, TMS 30555, and TMS 50395. Darker coloured dried chips produced darker coloured fried chips.

Chip taste differed according to chip colour (Fig. 6). As Colour rating decreased, the chip became slightly bitter. Taste was found to be negatively correlated with total soluble sugar concentration in the flour (Fig. 7) Apparently the sugars, especially the reducing sugars, reacted with the amino acids and possibly with other compounds leading to some browning reactions that also produced bitter compounds (1). Total HCN in flour did not correlate with chip taste. However, the residual bound cyanide may have contributed to the bitter taste. Linamarin, the compound in which HCN is mainly present in the undamaged cassava cells, is bitter (16).







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