DEVELOPING QUICK METHODS TO COOK WHOLE SORGHUM

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ABSTRACT

Consumption of whole grain sorghum increases intake of bioactive compounds and fiber significantly. The objective of this study was to evaluate the use of thermal treatments to reduce cooking time of whole sorghum. A hot air stream treatment; a microwave and a combination of both methods were used to pretreat four varieties of whole grains. Minimum Cooking Time (MCT) was obtained using the combination treatment and Sumac sorghum. Cooking time reduction varied in a range of 59% for Sumac (softer endosperm) to 73% for White (harder endosperm) Cooking time was affected mainly by hardness and grain size. Cooking quality and physical characteristics of cooked grain were evaluated.

INTRODUCTION

Whole sorghum depending on variety, hardness and kernel size, requires 30 to 45 min of steaming. A quick cooked sorghum with 5 to 15 min cook time would be useful Evaluation of thermal treatments to produce a quick cooked sorghum was the objective of this study. A white food-type, two types containing condensed tannins and a black high anthocyanin sorghum were evaluated. A hot air treatment, a microwave and a combination of these methods were used to pretreat the whole grains. Subsequent cooking time and cooking quality characteristics of sorghum grain were evaluated.

METHODOLOGY

Four varieties were evaluated: white food-type (ATx635x436), two special types containing condensed tannins (Sumac and high Tannin) and a black high anthocyanin sorghum. (Table 1). All sorghum samples were cleaned and soaked 16 hours to increase moisture (28%-30%) before grain pretreatment.Control treatment was just cleaned and soaked . The treatment conditions are shown in Table 2.

Table 1. Sorghum kernel physicochemical characteristics.

Variety	Color L, a, b			Protein DB(%)	Hardness (%)	Weight (mg.)	Diameter (mm.)
SUMAC	37.5	10.2	7.59	10.6	45.3	16.5	0.5
BLACK	34.1	4.6	2.5	11.1	60.3	40.4	2.7
H. TANNIN	41.7	15.1	13.1	10.5	65.2	24.2	1.87
WHITE	62.4	4.09	18.8	9.4	88.6	28.9	2.4

Table 2. Thermal treatments conditions to pretreat sorghum.

TREATMENT	DESCRIPTION
Hot air steam	The grain is exposed to circulating hot air stream (82ºC) in a popping machine by 45 sec. or until the grain is ready to pop.
Microwave	Grain is microwaved on high for 1 min. Microwave frequency was 896 (MHz), 34 cm wavelength.
Combination of Microwave and Hot air	Grain is microwaved for 1 min then exposed to circulating hot air stream for 1 min.
Control	Grain is just cleaned then soaked/non-treated.

VARIABLES MEASURED

- **Minimum Cooking Time (MCT): Time required to fully cooked sorghum. Cooking completion was tested by pressing the kernels between two glass plates and examining the loss of opaqueness in the center.**
- **Weight increase after Cooking (WIAC): Weight of cooked samples calculated as increase over initial weight of the grain.**
- **Solids losses (SS): Determined from cooking broth (AACC, method 44.15 (2003).**
- **Photomicrographs of pretreated kernel where taken using Electroscan Environmental Scanning Electron Microscope, Model E-3, accelerating voltage of 20 Kv.**
- **Pearson correlations were calculated to assess the association among cooking quality parameters (Table 3).**

RESULTS AND DISCUSSION

- **Color and size of pretreated cooked grain changed. Combination of hot air and microwave treatment produced pericarp ruptures due to moisture lost.**
- **Microwaved grain pericarp looks intact for most of the varieties, but moisture lost was higher which reduced kernel weight. Grain color is darkest (Fig. 1)**

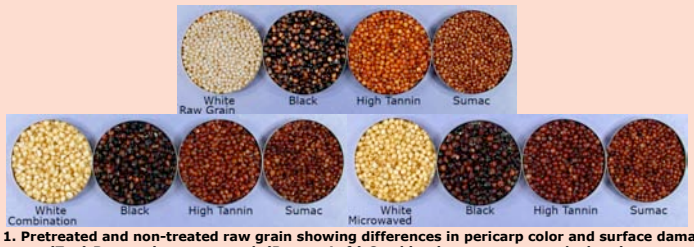
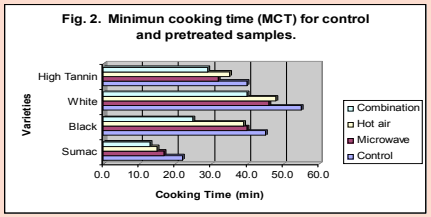
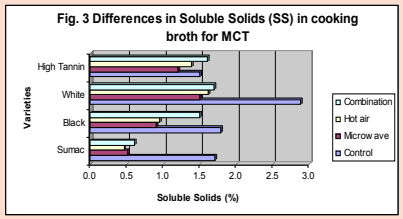


Fig. 1. Pretreated and non-treated raw grain showing differences in pericarp color and surface damage (Top) Raw grain non-treated. (Bottom Left) Combination treatment cooked grain. (Bottom Right) Microwaved cooked grain.





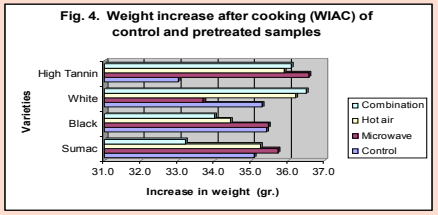


Table 3. Correlation coefficients among grain quality parameters of treated sorghum[a]

Cooking quality characteristics	(r)
Cooking time (min) vs	
Grain Hardness	0.72 *
% Weight increase after cooking	- 0.59**
% Soluble Solids in water	0.64*
kernel diameter	0.55**
Grain Color	0.86*
Kernel Protein	0.33
% Weight increase after soaking	0.45

a. Based on four sorghum varieties and treatments
*** Significant at 5%, ** Significant at 1%.**

- **Minimum cooking time was obtained using the combination treatment and Sumac sorghum. Cooking time reduction varied in a range of 59% for Sumac (softer endosperm) to 73% for White (harder endosperm) Cooking time was affected mainly by hardness and kernel size. Grain color and kernel diameter were positively correlated with this variable (Table 3).**
- **Increase in weight after cooking varied from 2.5% to 3% per sample. Minimum cooking time was negatively correlated with the variable weight increase after cooking (WIAC).**
- **Endosperm hardness and Minimum cooking time seemed to play a major role in Soluble solids determination. Microwaved grain produced minimum amount of soluble solids in cooking water.**

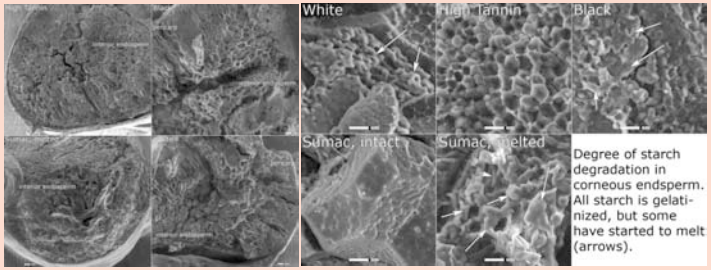


Fig. 5. Photomicrograph of cross-sections of pretreated sorghum kernel (Combination treatment) showing endosperm. (Left) Whole kernel. (Right) Corneous endosperm.

- **Combination of hot air and microwave pretreatment produced pericarp ruptures, allowing water and heat penetration to enhance starch gelatinization. Starch is completely gelatinized throughout the kernel. The interior of some kernels melted, which is characteristic of overcooked grain (Fig.5).**
- **Endosperm hardness and water uptake plays the major role in structural changes during cooking. Less tightly packed starchy endosperm cells (softer endosperm varieties) had shorter cooking time, than the more tightly endosperm cells (had endosperm varieties)**

CONCLUSIONS

- **The combination of hot air and microwave pretreatment reduce cooking time in a range of 59% to 73% for soft and hard endosperm respectively.Ruptures of the pericarp allowed water and heat penetration into the kernels and shorter cooking times.**
- **Endosperm hardness and kernel size affected Minimum cooking time and played a major role in soluble solids determination.**
- **Pretreatment of sorghum is required to reduce cooking time.**
- **More efficient methods could be used.**

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