Sensory perception of bitterness and astringency in sorghum

by

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Submitted in partial fulfilment of the requirements for the degree

PhD

Food Science

in the

Department of Food Science
Faculty of Natural and Agricultural Sciences
University of Pretoria
Pretoria
South Africa

April 2008

DECLARATION

I hereby declare that the thesis submitted at the University of Pretoria for the award of PhD degree is my work and has not been submitted by me for a degree at any other university or institution of higher learning.

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April 2008

ABSTRACT

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There is a conflict of interest between the sorghum producers, for whom condensed tannins in sorghum have agronomic advantages, and sorghum users for whom condensed tannins in sorghum are perceived as nutritionally harmful and unpalatable. However, in recent years there has been growing interest in food phenolics due to their antioxidant potential. Thus, enhancing the content of phenolic compounds in plant foods through selective breeding and/or genetic improvement is now being viewed as a potent dietary option for disease prevention and control. However, the objectionable sensory attributes (bitterness and astringency) of phenolic compounds, especially condensed tannins, have resulted in low consumption of foods rich in these compounds. This study investigated the sensory attributes of products of sorghums varying in total phenol and condensed tannin content as well as their acceptance.

A descriptive sensory panel described the sensory attributes including bitterness and astringency of two products, sorghum rice and bran infusions of six sorghum cultivars: three containing tannins and three with no detectable tannins. The products of all the sorghums (tannin and tannin-free) were perceived to different degrees as both bitter and astringent. The products of sorghums with the highest total phenol and tannin content were most bitter and astringent while those from tannin-free sorghums with the lowest total phenol content were least bitter and astringent. The products of NS 5511 (tannins - 1.8% catechin equivalents CE), were perceived similar in both bitterness and astringency to those of a tannin-free sorghum (PAN 8564). Using the Dual Attribute Time Intensity (DATI) sensory method the descriptive sensory panel determined the intensity and time course of bitterness and astringency of bran infusions of sorghums varying in total phenol and condensed tannin content. The infusion from the sorghum with the highest condensed tannin content (PAN 3860) was perceived as most bitter and most astringent and that from

the tannin-free sorghum with the least total phenol content (Phofu) was least bitter and astringent. Bitterness of the sorghum infusions developed and reached maximum intensity significantly faster than astringency. The total duration of the astringency sensation lasted significantly longer than bitterness. The more bitter and more astringent the sorghum was, the longer the persistence of the bitter and astringent after-taste. The infusion of NS 5511 was again perceived similar to tannin-free sorghums in both bitterness and astringency. These findings seem to suggest that there is a condensed tannin threshold level at which the tannins are not 'strongly' perceived and thus are not objectionable.

A consumer panel classified by 6-n-propylthiouracil (PROP) taster status assessed the colour, texture, flavour and overall liking of sorghum rice of two tannin-containing (tannin) sorghums and two tannin-free sorghums. The sorghum rice from PAN 3860, with the highest tannin content, received significantly lower acceptance ratings for all the sensory attributes than the other sorghums. With the exception of appearance, the acceptance of the sorghum rice from the tannin sorghum NS 5511 was not significantly different from that of the two tannin-free sorghums. The PROP tasters (medium and super) could distinguish differences among the sorghum cultivars varying in tannin content levels which presumably led to the significant difference in their acceptance ratings for the most bitter and astringent sorghum compared to others. On the other hand the non tasters preferred the cultivars equally, presumably because they could not detect taste differences (in bitterness and astringency) between the sorghum cultivars. The results of the consumer panel confirm the predictions made from the descriptive sensory panel results that not all the tannin sorghum products would be objectionable to consumers.

It is proposed that the condensed tannin threshold level is 2.0% CE inclusive of the tannin content level of NS 5511 (1.8% CE). It is recommended that future breeding programmes investigate production of sorghums like NS 5511 with condensed tannin levels that fall within this threshold limit. The level of condensed tannins in these sorghums would provide the agronomic advantages for the farmer by reducing pre-harvest and post-harvest losses as well as provide the antioxidant benefits associated with them without negatively affecting the nutritional value of the food/feed. Since the negative sensory properties of these sorghums are not strongly perceived they would not be objectionable to consumers, thus making them a promising health option for millions of people.

DEDICATION

This work is dedicated to my late father Arrat Esrom Kobue, who encouraged
me to reach higher heights.

ACKNOWLEDGEMENTS

I praise and thank my Lord and my God for giving me the wisdom, guidance, direction, endurance, good health and well being throughout my studies. To God be all the glory!

My sincere thanks to my supervisor Dr. H.L. de Kock, for her willingness to work with me, for her wisdom and wealth of knowledge in the secret world of sensory science. I appreciate her patience and open door policy.

My deepest gratitude goes to my co-supervisor Prof J.R.N. Taylor for his sincere interest in my work, for his excellent and timely guidance, his insight and challenging questions, his constructive criticism, and for challenging me to reach higher.

I wish to thank Dr. M. van der Linde and Dr. F.H.J. Kanfer of the Department of Statistics of the University of Pretoria for their assistance with some of the statistical analysis of the research data.

I sincerely thank Linda Dykes and Dr. Lloyd W. Rooney, Cereal Quality Laboratory, Soil & Crop Sciences Department, Texas A&M University, USA for the HPLC analysis of the sorghum samples.

A big thank you to the staff and fellow students in the Food Science department, especially Martin Kebakile, Janet Taylor, Mathoto Thaoge-Lefyedi and Gyebi Duodu for their friendship and encouragement, and to all those who shared the love of Christ with me.

Last but certainly not least, my loving husband Mothusi Lekalake for understanding that I needed to do this; for the sacrifices he was willing to make not only financially but allowing the kids and I to re-locate to Pretoria; his unwavering support, his patience, … I thank my children: Rorisang, Tetlanyo and Lefika for understanding why I needed to do this. I thank the rest of my family for being there, cheering me on.

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