Finger millet grain phenolics and their impact on malt and cookie quality

by

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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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Phenolics in finger millet (FM) grain, including tannins, may impact significantly on its antimicrobial properties, functionality and health-promoting potential. Unfortunately, the location of tannins in the grain is unknown and there is limited information on the influence of variety on grain phenolic composition and antioxidant activity (AA). The effect of phenolics in FM grain on its malt fungal load and on the functional quality of its food products, including baked goods, is barely known.

Twenty two FM grain types of varied visual kernel colour were analysed to determine the influence of grain type on phenolic composition, AA, and tannin localisation in the grain. Condensed tannins, anthocyanins and flavan-4-ols were detected. Light coloured grain types had no tannins and had much lower total phenolics (TP) relative to the pigmented types, and types that stained black with the Bleach test had much higher tannin content and much higher AA. The grains that stained black with the Bleach test and had high tannin content (0.60 to 2.08 mg catechin equivalents/100 mg, db) had a dark coloured testa layer, indicating that the tannins were located in that layer. The results indicate that occurrence of tannins in FM is a varietal property and the tannins are predominantly responsible for the AA of the grain.
Germinative energy (GE), enzymic activity, and total fungal count [TFC], and infection levels of 12 FM grain types of varied phenolic content were measured to determine the impact of phenolics in FM grain on its malt quality. The malt quality of high-phenol FM types was much higher than that of the low-phenol types, with respect to enzymic activity. TFC was negatively correlated with grain total phenolics (TP) and amount of phenolic type (APT) and there were some negative correlations between fungal species infection levels and TP and APT (p<0.05). GE and enzymic activity were positively correlated with TP and APT (p<0.05) and negatively correlated with TFC (p<0.01). The data indicate that phenolics in FM grain impact positively on its malt quality by contributing to its antifungal activity.

Cookies in which wheat cake flour was substituted with 15, 35 and 55% (w/w) of either a non-tannin or a high-tannin FM flour were analysed to assess the impact of FM phenolics on cookie quality and AA (health-promoting potential). FM-substituted cookies, particularly those with high levels of the high-tannin FM, were inferior to cake flour cookies (control), with respect to spread, texture and integrity and their dark colour decreased their acceptance by a consumer panel. However, the acceptability of cookies containing up to 35% of either FM type was similar to that of control cookies. Cookies containing the high-tannin FM had antioxidant activities that were similar to or higher than the antioxidant activities of several plant products on the market. Thus, potentially health-promoting cookies can be made by substituting up to approximately 35% wheat with a high-tannin FM.

The study indicates that high-phenol FM grain types have good malt quality, which is partly due to the antifungal activity of their phenolics. Although FM phenolics, particularly tannins, seem to affect cookie quality negatively, they contribute significantly to their health-promoting potential.
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# TABLE OF CONTENTS

DECLARATION ...................................................................................................................................... ii  

ABSTRACT ......................................................................................................................................... iii  

ACKNOWLEDGEMENTS ................................................................................................................... v  

TABLE OF CONTENTS ..................................................................................................................... vi  

LIST OF TABLES ............................................................................................................................. ix  

LIST OF FIGURES .......................................................................................................................... xi  

1. INTRODUCTION ............................................................................................................................. 1  
   1.1. Statement of the Problem ........................................................................................................ 1  
   1.2. Literature Review ................................................................................................................. 3  
      1.2.1. Finger millet grain structure and composition .............................................................. 3  
         1.2.1.1. Structure of the finger millet grain .................................................................. 3  
         1.2.1.2. Composition of the finger millet grain ............................................................. 6  
      1.2.2. The chemical nature, occurrence and classification of plant phenolics and their signif... 11  
      1.2.3. Antioxidant activity of plant phenolics ........................................................................ 15  
      1.2.4. Finger millet grain phenolics and their localisation, and their contribution to the antio... 17  
      1.2.5. Potential health-promoting effects of plant phenolics with particular reference to sorgh... 20  
      1.2.6. Contamination of sorghum and finger millet grains and malts by fungi and mycotoxins... 21  
         1.2.6.1. Contamination of sorghum and finger millet grains by fungi and mycotoxins ....... 21  
         1.2.6.2. Production of sorghum and finger millet malts and their contamination by fungi and... 23  
         1.2.6.3. Effect of malting on the phenolic content of sorghum and finger millet ............ 27  
         1.2.6.4. Relationship between phenolic content and amount of phenolic type and resistance... 30  
         1.2.6.5. Proposed mechanisms of antimicrobial activity of phenolic compounds ....... 33  

vi
2.2.6. References ..............................................................................................................88

2.3. Effect of partial substitution with finger millet on the nutritional and functional quality of cookies, with particular reference to phenolics .................................................................99

2.3.1. Abstract ..................................................................................................................99
2.3.2. Introduction ............................................................................................................99
2.3.3. Materials and Methods ..........................................................................................101
  2.3.3.1. Wheat and finger millet flours .....................................................................101
  2.3.3.2. Rheological analysis.....................................................................................101
  2.3.3.3. Baking ..........................................................................................................102
  2.3.3.4. Nutritional analyses......................................................................................102
  2.3.3.5. Spread and thickness ....................................................................................102
  2.3.3.6. Texture .........................................................................................................103
  2.3.3.7. Colour...........................................................................................................103
  2.3.3.8. Sensory evaluation .......................................................................................103
  2.3.3.9. Chemical analysis.........................................................................................104
  2.3.3.10. Statistical analysis ........................................................................................104
2.3.4. Results and Discussion .........................................................................................105
2.3.5. Conclusions ..........................................................................................................125
2.3.6. References ............................................................................................................125

3. GENERAL DISCUSSION .................................................................................................132
  3.1. Methodologies.............................................................................................................132
  3.2. Research findings ......................................................................................................144
  3.3. Finger millet is a premium cereal grain for human food? .............................................150

4. CONCLUSIONS AND RECOMMENDATIONS ..............................................................155

5. REFERENCES .................................................................................................................157

6. APPENDIX ......................................................................................................................189
Table 1.2.1. Chemical composition of finger millet grain ..............................................................8
Table 1.2.2. The major classes of plant phenolics .......................................................................12
Table 2.1.1. Finger millet types and their origin...........................................................................42
Table 2.1.2. Kernel characteristics, phenolic content and antioxidant activity of different finger millet grain types ......................................................................................................47
Table 2.1.3. Pearson’s correlation coefficients between kernel characteristics, phenol content, and antioxidant activity of finger millet grain types ...............................................................53
Table 2.2.1. Kernel characteristics, total phenolics and amount of phenolic type and fungal infection of finger millet grain ......................................................................................................67
Table 2.2.2. Pearson’s correlation coefficients between kernel characteristics, total phenolics and amount of phenolic type and fungal infection of finger millet grain ...................................................70
Table 2.2.3. Fungal load and fungal types on finger millet grain types and their malts...............74
Table 2.2.4. Pearson’s correlation coefficients between finger millet grain total phenolics and amount of phenolic type and fungal load of finger millet malt ......................................................75
Table 2.2.5. Germinative energy (GE) and malt quality of finger millet grain types .................81
Table 2.2.6. Pearson’s correlation coefficients between finger millet grain total phenolics and amount of phenolic type and germinative energy and malt quality .................................82
Table 2.2.7. Effect of malting on the nutrient content of finger millet grain types (g/100 g, db).86
Table 2.2.8. Effect of malting on the amino acid composition of finger millet grain types .........87
Table 2.3.1. Rheological properties of composite wheat-finger millet doughs ..........................105
Table 2.3.2. Proximate composition (g/100 g) of cake and finger millet (FM) flours, and composite wheat-FM cookies .....................................................................................................................110
Table 2.3.3a. Amino acid composition of cake and finger millet (FM) flours, and composite wheat-FM cookies (g/100 g, db) ..............................................................................................................111
Table 2.3.3b. Comparison of essential amino acid concentration in composite wheat-finger millet (FM) cookies with the pattern of essential amino acid requirements .....................................112
Table 2.3.4. Physical characteristics of composite wheat-finger millet cookies .......................116
Table 2.3.5a. Sensory acceptability of composite wheat-finger millet cookies .........................117
Table 2.3.5b. Effect of finger millet type and finger millet substitution level on sensory acceptability of composite wheat-finger millet cookies .................................................................117

Table 2.3.6. Effect of baking on the assayable phenolic content and antioxidant activity of composite wheat-finger millet cookie doughs ...........................................................................118

Table 2.3.7. Comparison of the antioxidant activity of composite wheat-finger millet cookies with that of some food products in the market .................................................................121

Table 2.3.8. Pearson correlation coefficients between phenolic content, antioxidant activity, texture, colour and sensory acceptability of composite wheat-finger millet cookies........................................................................................................124

Table 3.1. Merits and demerits of finger millet grain as a human food .................................................154
LIST OF FIGURES

Figure 1.2.1. Structure of anatomical parts of the finger millet grain ............................................4
Figure 1.2.2. Phenolic acids. A, p-Hydroxybenzoic acid; B, Hydroxycinnamic acid (caffeic acid). .................................................................13
Figure 1.2.3. Basic structure and numbering system of flavonoids ..................................................13
Figure 1.2.4. General structure for proanthocyanidin higher oligomers and polymers ..............13
Figure 2.1.1. Light micrographs of finger millet kernels ..............................................................49
Figure 2.1.2. SEM of testa area of finger millet kernels ...............................................................50
Figure 2.3.1. Effect of finger millet substitution level on the rheological properties of composite wheat-finger millet (FM) doughs ..........................................................107