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

by

**Muthulisi Siwela**

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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.**

**Muthulisi Siwela**

**February 2009**

# ABSTRACT

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

**by**

**Muthulisi Siwela**

Supervisor: Dr. K.G. Duodu
Co-Supervisors: Prof. J.R.N. Taylor
Prof. W.A.J. de Milliano
Department: Food Science
Degree: PhD (Food Science)

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 eqivalents/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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