

CHAPTER 1

INTRODUCTION

Pearl millet (*Pennisetum glaucum* (L.) R. Br.), known as "mexoeira" (Portuguese), "hanzelo" (Rhonga), "whahuva" (Shangaan) and "mhala" (Xitswa) in Mozambique, as "babala", "manna" (Afrikaans), "nyalothi" (southern Sotho), "inyouti" (Ndebeli), "mhuga", "mhungu" (Shangaan), "unyaluthi", "unyawothi" (Zulu), "leötsa" (northern Sotho) and "lebelebele" (Tswana) in South Africa, and as "mapfunde" (Shona) in Zimbabwe is a drought tolerant cereal crop grown primarily as a food grain in Southern Africa. Data from the FAO (1998) refers that although Mozambique produces only 11% of the total millet production of the Southern Africa, the utilisation of pearl millet for human consumption in this country is about 90% of the respective production, which is the highest in the region.

One of the main constraints in utilization of pearl millet in the industry is the small size of the grain. It also has a large germ which gives rise to the rapid development of fatty acids in whole pearl millet meal, mainly due to the action of lipase (Lai & Varriano-Marston, 1980a) which causes bitterness and makes meal unacceptable within 5 to 8 days after milling (Kaced, Hosney & Varriano-Marston, 1984). Ground pearl millet also generates a mousy odour when stored for any length of time. Reddy, Faubion & Hosney (1986) found that this odour is not associated with oxidative rancidity of kernel lipids, but with enzymatic deterioration, as the odour generation requires relatively high moisture levels in the grits.

The utilisation of millets is also limited due to the presence of various anti-nutrients, poor digestibility of proteins and carbohydrates, and low palatability (Sharma & Kapoor, 1997). Various processing technologies are, however, able to affect positively the physicochemical composition of food grains, in

order to improve their nutritional value. Such primary processing technologies include fermentation and malting. Malting is a primary processing technology which describes the process of soaking or steeping the dry grains in water until they are saturated, followed by germination under controlled conditions for a specific period (reviewed by Chavan & Kadam, 1989). Malting is relatively easy and can be carried out without sophisticated equipment.

The process of malting (sprouting) is commonly used for the production of traditional foods. Malting improves the vitamin content of pearl millet and lowers levels of lipids, phytate, and oxalate (Opoku, Ohenhen & Ejiofor, 1981). The concentration of free sugars, amino nitrogen, B vitamins, and ascorbic acid are increased as well (Hamad & Fields, 1979), due to the partial loss of soluble carbohydrates by respiration. The partial protein digestion via intrinsic grain enzymes or extrinsic (microorganisms) proteolytic enzymes improves protein quality and digestibility (Serna-Saldivar, McDonough & Rooney, 1990).

1.2 OBJECTIVES

1.1 objective STATEMENT OF THE PROBLEM

To develop and optimise pearl millet malting conditions suitable for use in Mozambique.

With the continued increase in the Mozambican and southern African population great emphasis has been placed throughout the region on increasing the production of plant foods, improving their nutritional quality, and developing simple and economical methods for their storage and processing. Therefore, malting technology appears to be one of the low-cost technologies that could be used for nutritional improvement of cereal grains such as pearl millet.

In Mozambique and other parts of southern Africa pearl millet is often traditionally processed by sprouting prior to consumption. Sprouting is used to make weaning foods for infants. Malted pearl millet is also brewed to make “uphutsu” and other low alcohol beverages, consumed specially during

traditional ceremonies and other occasions. These low-alcoholic beverages are largely consumed not only during traditional ceremonies, like Masses and weddings “lobola”, but also by the low-income groups, which are increasing due to financial-economical reasons.

For commercial brewing, much of the malt used in Mozambique and other SADC (southern African Development Community) countries is from barley. Since barley cultivation in the SADC region is not generally economically feasible; the barley malt used is mostly imported from overseas which makes it very expensive. Therefore, pearl millet could be an alternative for increasing malt availability for both traditional and industrial use at low cost in the SADC countries.

1.2 OBJECTIVES

The objectives of this project were:

- To develop and optimise pearl millet malting conditions suitable for the southern African food industries, with special emphasis on weaning foods, other starchy foods, traditional and conventional brewing.
- To determine the pearl millet grain structure and modification occurring during and due to malting.
- To determine the effects of malting on the physico-chemical, nutritional and functional properties of pearl millet.
- To determine the effect of malting on anti-nutrients in pearl millet, i.e. phytate and polyphenols.

- To determine the effects of malting on the off-odour which appears in pearl millet when ground.

LITERATURE REVIEW

2.1 MORPHOLOGY OF PEARL MILLET

The structure of the mature pearl millet caryopsis is very similar to that of sorghum caryopsis but with several differences (reviewed by Serna-Saldivar & Rooney, 1995). In comparison with sorghum, pearl millet is a smaller grain with a proportionally larger germ and consequently a smaller endosperm (Abdelrahman, Hoseney & Vernano-Marston, 1984). Pearl millet grain reported to consist of 73.9-75.2% endosperm, 13.5-17.4% germ, and 8.5-10.5% pericarp (Table 1) (Abdelrahman, Hoseney & Vernano-Marston, 1984).

The pericarp of pearl millet consists of the epidermis, mesocarp, and chlorenchyma of variable thickness. Culebras with thick pericarps do not have starch granules in the mesocarp (reviewed by Serna-Saldivar & Rooney, 1995).

The sub-aleuronic endosperm has a very dense protein matrix with only small starch granules in the first one or two cell layers (reviewed by Serna-Saldivar & Rooney, 1995). The corneous (horny or vitreous) area contains small, uniformly sized polygonal starch granules embedded in a protein matrix with small numbers of protein bodies. The respective average sizes of starch granules and protein bodies are 6.4-7.6 and 0.6-0.7 μm (reviewed by Serna-Saldivar & Rooney, 1995).

As stated, the pearl millet germ is proportionally larger than most other cereals. It contains an embryo and scutellum. Pearl millet scutellar epidermal or epithelial cells are very similar to those of sorghum (Zeleznack & Vernano-Marston, 1982). A dark pigmented material (black layer) is deposited