CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

The finding that modification of pearl millet grain structure during malting started at the germ floury endosperm interface and moved in the direction of the peripheral endosperm together with the finding that there was not much modification of the cell walls, aleurone layer or the horny endosperm shows that the pattern of modification in pearl millet is indeed similar to that of sorghum and different from that of barley.

The similarity of pearl millet with sorghum is also in the fact that non-germinated grains of pearl millet do not exhibit DP, α- or β-amylase activity.

The optimum malting conditions for high DP, α- and β-amylase activity, good FAN, and moderate malting loss are 25-30°C and 3-5 days germination, medium watering treatment. However, if the malting process is to be conducted in a short period of time, i.e. 1-3 days, the germination temperature and watering regime should be higher, 30-35 °C, high watering treatment. The levels of DP, FAN, α-amylase activity and malting loss of pearl millet malts, which are similar to sorghum malts, represent an excellent potential for utilisation of pearl millet for opaque beer brewing purposes. Additionally, pearl millet malt could be better than sorghum as an alternative for lager beer brewing due to the fact that it has higher β-amylase activity.

The high level of malt extract found in pearl millet malt, around 70%, together with the fact that malting considerably reduced the fat content to the levels which occur in barley, is an indication that pearl millet malt can be used in lager beer brewing at least as a barley malt extender. However, brewing studies are recommended to find out to what extent pearl millet malt can substitute barley malt in the production of lager beer. At the above mentioned optimum germination conditions, the malting losses were moderate. This is an important finding since minimum malting loss and maximum achievable extract per unit weight of malt can increase the profitability of the brewing operation by lowering the production costs.

Variety affected most malt quality parameters, with variety SDMV 89004 producing better malt quality than variety SDMV 91018, possibly on account of its higher germinability.

Malting increases the percentage of the total carbohydrates which are enzyme susceptible, but reduces the total carbohydrate in pearl millet. The increase in the percentage of the total carbohydrates which are enzyme susceptible is due to starch hydrolysis into short chains of glucose (dextrins) and fermentable sugar maltose by endogenous amylases. The reduction in the total carbohydrate, is due to utilisation of some carbohydrates in malting to provide energy for germination changes, should not be very accentuated if malts are meant for the preparation of traditional southern African food products, such as porridges, weaning foods for infants and unleavened bread, where comparatively less carbohydrate reduction may be advantageous, to prevent the decrease of energy and nutrient density of the food products.

The decrease in fat during the germination process brings an increase in palatability of pearl millet food products since it reduces the possibility of development of free fatty acids, which occurs mainly due to the action of lipase, causing bitterness and makes the meals unacceptable within a few days.

The increase in the Water Solubility Index and soluble nitrogen with germination is of significant importance, since it gives an indication that germination can be used to increase the amount of soluble materials, carbohydrates and amino acids, which can be easily digestible, in pearl millet food products. The increase in soluble proteins and consequently in Nitrogen Solubility Index, due to partial hydrolysis of storage proteins by endogenous proteases produced during the germination process, which makes the partially hydrolysed storage proteins more available for pepsin attack, is probably responsible for the increase in protein digestibility observed in pearl millet malts.

Although there were small changes in the amino acid profile, due to transamination, during germination, generally, germination imparted little change to the amino acid composition of the two pearl millet varieties investigated. The lysine content of the protein of germinated pearl millet of SDMV 91018 variety accounted for about 75% of the FAO Scoring Pattern.

Of particular nutritional importance is the decrease in phytic acid content of pearl millet during malting. This is probably due to phytase activity. The reduction in phytic acid can improve the bioavailability of both protein and essential minerals in pearl millet.

The reduction of pearl millet flour viscosity by malting is of functional importance in the SADC region and most other African countries, where porridge is a staple food. Porridges of high viscosity are more preferable for adults, because they are often eaten with fingers. Porridges of low viscosity are suitable for consumption by infants as weaning foods due to their limited stomach capacity and inability to chew. The reduction in pasting peak viscosity may be attributed to the greatly increased α-amylase activity in the malt. Such reduction in porridge viscosity is nutritionally important since it leads to acceptable weaning food consistency.

As with brewing malt quality parameters, variety SDMV 89004 produced malts of higher nutritional and better functional properties than SDMV 91018. The higher Germinative Vigour and Germinative Energy could be the reason for the better nutritional and functional properties exhibited by the variety SDMV 89004.

Germination successfully almost eliminated the mousy odour, characteristic of pearl millet meals after short periods of storage. The water-soluble phenolics responsible for the generation of the mousy odour may have been inactivated or reduced to very low levels due to decrease in pH (by the growth in lactic acid bacteria) and by leaching out the phenolic pigments or as a result of the metabolic changes which took place in the germ during germination.

The findings that the mousy odour is almost eliminated by germination and the fact that malting can be carried out at potentially low cost without sophisticated and expensive equipment is very important to the rural communities of Africa and India who rely on pearl millet meals for their energy and other nutritional requirements. Additionally, the fact that the malting conditions and subsequent malt quality of pearl millet are similar to those of sorghum makes pearl millet malts suitable for the production of sorghum type beer widely consumed in the rural areas of Semi-Arid Tropics (SAT).