CHAPTER 1

Introduction

With the continued increase in the world population and pressures on agricultural land, food scientists, technologists and nutritionists have been greatly concerned not only about the quantity of food but also about the quality of food. The food technologies have provided alternatives for improving the nutritional quality of plant foods. One such procedure which is simple and has wide application at home is germination of grains (Hamad and Fields 1979). According to Lorenz (1980) grains can be germinated at home without sophisticated equipments. Earlier, Wang and Fields (1978) had opined that germinated and malted grains can serve as nutritious ingredients from which nutritious food products can be produced.

Germination and development of sprouts from seeds have been regarded as a number of consequtive steps causing rather low moisture seeds to show a rise in metabolic activity which leads to the formation of a protrusion from the embryo (Lorenz 1980). Two of the favourable conditions required for a viable seed to germinate and develop sprouts are an adequate water supply and a desirable temperature (Mayer and Poljakoff-Mayber 1982).

The water uptake by a seed, however, is influenced by certain factors, such as, initial moisture content, grain size, nutrient composition, and the structure and composition of grain layers (Butcher and Stenvert 1973, Brookes et al 1976). During water uptake, initiation of certain metabolic activities takes place which leads to 'modification' of a grain. The sum total of physical and chemical changes which take place during malting is termed as 'modification' (Pomeranz 1972). The modification includes transformation of a tough grain into a friable malt and activation and elaboration of hydrolytic enzymes which in turn, bring about hydrolytic changes in carbohydrate and protein fractions of a grain.

The enzyme diastase, comprising mainly of alpha and beta amylases, was found to be responsible for the hydrolysis of starch in germinated grains (Olered and Jonsson 1970, Kruger 1972, Lineback and Ponpipom 1977). Also a relationship between germination time and reduction in starch, and increases in reducing sugars of a grain has been reported (Chavan et al 1981, Taur et al 1984a, Sathe et al 1983).

Hwang and Bushuk (1973), Ganesh Kumar and Venkataraman (1978) and Duranti et al (1984) have demonstrated that the proteins of a grain are hydrolysed during the process of germination. In addition, small increases in protein content of a grain have also been reported (Kylen and McCready 1975, Harrison and Vanderstoep 1984).

Cereal grains are at present the most important source of calories and protein for most of the world (Clausi 1971, Singh and Jambunathan 1980). Wheat is estimated to provide 20% of the total world calories and is the staple food in about 45 countries. Therefore, treatments which improve the nutritive quality of whole wheat flour become important (Lemar and Swanson 1976). Germination of wheat has been considered as one of the procedures to improve its nutritive quality.

Legumes have occupied an important place in human nutrition as rich sources of proteins, vitamins and minerals, particularly in developing countries (Singh 1984). In addition to complementing cereal protein (Warren et al 1983), grain legumes also make a significant contribution to total energy intake (Saini and Knights 1984). Like cereals, legumes can be germinated to enhance their nutritive value (Jaya and Venkataraman 1980).

Nutrient composition of grains has been reported to vary due to variety, class, location, crop year and a combination of these factors (Davis et al 1981, Davis et al 1984). Germination and malting have been shown to improve the nutritive quality of ~~the~~ grains by enhancing the contents of nutrients, like protein (Opoku et al 1981, Wu 1982, Wu 1983, Opoku et al 1983, Harrison and Vanderstoep 1984), amino acids such as lysine and tryptophan (Tsai et al 1975, Dalby and Tsai 1976, Ram et al 1979, Wu and Wall 1980, Wu 1982, Wu 1983), fat (Bates et al 1977, Ranhotra et al 1977, Wu 1982), calcium (Khader 1983, El-Shimi et al 1984), iron (Brandtsaeg et al 1981), thiamine (Hasim and Fields 1979, Geervani and Theophilus 1980, Opoku et al 1981), and riboflavin (Nandi 1960, Hasim and Fields 1979, Hsu et al 1980, Opoku et al 1981, Brandtzaeg et al 1981, Abdullah and Baldwin 1984).

In addition, it has been shown that during the process of germination the quality of grain proteins is improved because of hydrolysis of proteins (Hwang and Bushuk 1973, Ganesh Kumar and Venkataraman 1978, Duranti et al 1984). Khan and Ghafoor (1978) had exhibited a 2.5 fold increase in the protein efficiency ratio (PER) value of 2 days germinated mash bean (Phaseolus mungo) proteins. El-Hag et al (1978) had demonstrated that the digestibility coefficient (DC) value of 10 days germinated red kidney bean (Phaseolus vulgaris) protein had increased from 29.5 (initial value) to 66.4%. Earlier in 1973, Palmer et al had observed increases in DC and net protein utilisation (NPU) values after 8 days of germination of kidney beans. Fotedar (1981) had reported that the PER value of malted mix protein, prepared from malted wheat (Triticum aestivum) and bengal gram (Cicer arietinum), was significantly higher than that of the roasted mix protein. However, somewhat contradictory results have also been reported (Bates et al 1977) that the quality of grain proteins became inferior following germination as indicated by PER values.

Green leafy vegetables are a good source of calcium, iron and carotenes, some are also good sources of high quality protein (Sehgal et al 1975). The important contribution of green leafy vegetables to the intakes of calcium, iron and carotenes was illustrated by Rajalakshmi et al (1975), Devadas et al (1980) and Jayarajan et al (1980). The high supplementary value of green leaves to cereal proteins has also been demonstrated (Talwalkar and Patel 1970a, Naik et al 1978).

The utilization of cereal-pulse mixtures for human consumption is considered to be one of the best options to increase the nutritional status of the population specially when a readily available mix can be incorporated into a product which is a part of the usual diet (Hernandez and Sotelo 1984). Malted grains have been used in the preparation of such mixtures to enhance their nutritive value.

The malted grains have been utilized mainly in the preparation of weaning foods (Brandtzaeg et al 1981, Malleshi and Desikachar 1982, Nayak 1983, Gandhi 1985). The authors have demonstrated decreases in viscosity and consequently increases in caloric density of a gruel prepared from malted grains. Although malted grains are nutritionally superior to raw grains, yet so far, no attempts have been made to use the malted grains in the preparation of a snack for school going children, pregnant and lactating women, and geriatrics.

Biscuits are popularly consumed as snacks by the people from all classes and of all age groups and are especially liked by children. As such, these may be considered as an ideal carrier for the supply of calories and other nutrients to the vulnerable groups (Diwan et al 1982).

It was after the 1960's that more emphasis was laid on calorie rich foods than protein rich foods. The idea of a calorie rich biscuit was first conceived by the Dunn Nutrition Unit, Cambridge as presented in Food (1985); feeding trials were carried out in Gambia using locally produced biscuits made from peanuts (Arachis hypogaea). In 1981, Oxfam Medical Unit prepared biscuits from wheat flour, vegetable and butter oils and dried skim milk powder. Each biscuit weighed 25 g and provided 125 kcals, a feed of two biscuits each twice a day provided 500 kcals per day.

A product after development needs to meet consumer satisfaction. Cardello and Maller (1982) suggested that a number of techniques are available to measure consumer likes and dislikes for food. Most of these techniques can be subsumed under the rubrics of 'preference', 'acceptance' and 'consumption' measurements. 'Preference' is the expressed degree of liking or disliking for a food when obtained in response to a food 'name', 'acceptance' is the expressed degree of liking or disliking for a food when obtained in response to a 'prepared' sample of the food and 'consumption' is the number and/or amount of a food item(s) that is (are) actually ingested. According to the authors, the preference and acceptance measurements can be obtained by using hedonic scale while consumption can be determined by the proportion of servings eaten. Composite scoring tests have been used to determine the overall acceptability of the product and to evaluate the product in terms of its characteristics as colour, consistency, flavour and absence of defects (Swaminathan 1979).

The shelf life of flours and biscuits depends on the environmental factors like humidity, temperature, light and the packaging material used (Balasubrahmanyam et al 1981). During storage, flours of cereals and legumes tend to develop musty, rancid and bitter flavours because of their lipid contents. The flour lipids are susceptible to storage deterioration and their degradation has been correlated with the development of off flavours. The spoilage of flours is associated with oxidative and hydrolytic degradation of lipids which is influenced by the moisture content of the flours (Arya 1981).

Biscuits are highly moisture sensitive, they can be maintained crisp by high moisture proof barriers. Moreover, because they contain high percentage of fat (20%), the use of grease and oxygen proof packaging materials becomes necessary to minimize development of oxidative rancidity occurring in long term storage. However, in packaged biscuits, loss of crispness due to moisture ingress is considered to be a more serious problem than rancidity development. But biscuits, unlike bread, have an attractive feature of long shelf life, therefore, large scale production and distribution of biscuits is possible (Meimban et al 1982).

Thus the present study was undertaken to prepare biscuits from malted grains for the vulnerable groups and to investigate how further heat treatment in the preparation of biscuits would affect the nutritional quality of a mix prepared from malted grains.

Wheat and bengal gram, the most commonly used grains in Gujarat State were selected. Wheat protein is low in lysine, while bengal gram has a high protein and lysine content and has a very low concentration of antinutritional factors (Khader and

Venket Rao 1982). Except for a deficiency in sulphur amino acids (Chatterjee and Abrol 1975), the bengal gram protein is one of the best vegetable proteins and has been shown to be a good supplementation for cereals (Chandrasekharappa 1979). Colocasia (Colocasia antiquorum) leaf powder being rich in calcium, iron and beta carotene and fairly low in oxalic acid, and also being commonly used in the said State, was incorporated into the biscuits prepared from malted and raw mixes in order to enhance their nutritive value in terms of minerals and vitamins.

The specific objectives of the study were :

1) to determine the optimal soaking and germination time for wheat and bengal gram grains as indicated by their germinative capacity,

2) to study the changes in carbohydrate profile, and protein content of wheat and bengal gram in response to the process of germination,

3) to prepare biscuits from malted wheat and bengal gram mix with or without green leafy powder and to determine acceptability of these biscuits in comparison to that of biscuits prepared from raw mix,

4) to determine the nutritive composition of mixes and biscuits,

5) to determine the keeping quality of mixes and biscuits, and

6) to evaluate the growth promoting ability and protein quality of mixes and biscuits in an animal model.

In this dissertation, each experiment is presented as a separate chapter which comprises of introduction, materials and methods, and results and discussion pertaining to that experiment.