Review

# Malted wheat-based weaning food- a review

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 ***Received: 12.9.2018/Accepted: 18.11.2018***

## ABSTRACT

A brief review of literature on malted wheat for weaning foods and the nutritional changes after malting is presented. The benefits of malted wheat and problems related to wheat as weaning foods are described. Malting increases bioavailability of iron and zinc by reducing phytic acid levels. Germinated wheat contains 60 per cent less phytate than that of non-germinated mixture. While blending about 5 per cent cereal malt with high bulk weaning foods can reduce the dietary bulk by partial hydrolysis of carbohydrates without altering their amino acid content significantly. Wheat, green gram and jaggery with blended ratio of 70:30:25 after malting and roasting of grains had nutrient compositions within the range prescribed by the BIS for processed weaning foods.

**Keywords:** Weaning food; malting; bioavailability; dietary bulk; nutrients composition

## INTRODUCTION

Wheat (*Triticum aestivum*) grain is botanically a single-seeded fruit called caryopsis in which ripened ovary wall is fused to the end. Wheat is the dominant crop in temperate countries being used for human food and livestock feed. It is the second most important winter cereal in India after rice. In terms of production it is the second largest food grain crop grown in India with the total production of 96.64 MT as compared to 108.86 MT of rice annually. Over 80 per cent of the production is consumed in the form of various traditional products prepared from whole wheat flour. Bread wheat contributes approximately 95 per cent to total production while another 4 per cent comes from durum wheat and dicoccum share in wheat production remains only 1 per cent. It contains higher amounts of protein and energy as compared to other cereals and millets (Gopalan et al 1989). It contributes essential amino acids, minerals, vitamins, beneficial phytochemicals and dietary fibre components to the human diet and these are particularly enriched in whole-grain products (Shewry 2009).

World Bank data indicate that India has one of the world's highest demographics of children suffering from malnutrition (https://www.savethechildren.in/articles/malnutrition-in-india-statistics-state-wise). Nutrition may be the most important factor in the child's postnatal environment that affects resistance to diseases (Kadam et al 1984). The most important form of malnutrition prevailing in India is protein calorie malnutrition (Chakravarthy 1997). The legumes and cereals have the potential to alleviate food-related factors of malnutrition particularly among weaning age children. Cereals are generally deficient in lysine but have sufficient sulphur containing amino acids. However the legumes are rich in lysine but deficient in sulphur containing amino acids. Composite weaning food containing a proper mix of cereals and legumes may supply both lysine and sulphur containing amino acids.

### Benefits of malted wheat

Many cereal-based porridges are prepared by malting, a process that increases bioavailability of iron and zinc by reducing phytic acid levels (Ruel and Levin 2000). Amylase rich food (ARF) is germinated cereal

flour which is extremely rich in the enzyme alpha-amylase. The alpha-amylase cleaves the long carbohydrate chains in the cereal flour into shorter dextrins. It modifies the starch content of the cereals so that they do not thicken and would therefore not require dilutions resulting in enhanced digestibility (Inyang and Idoko 2006).

Prolonged germination times of up to 168 h led to a substantial increase of total dietary fiber and to a strong increase of the soluble dietary fiber by a factor of 3 whereas the insoluble fiber decreased by 50 per cent (Koehler et al 2007). Malting generally improves the nutrient content and digestibility of foods. Malting increased the bio-accessibility of iron by >2-fold from wheat and the bio-accessibility of zinc from wheat increased to an extent of 234 per cent. Malting marginally increased the bio-accessibility of calcium from wheat whereas malting did not exert any influence on bio-accessibility of copper from wheat; it significantly decreased (75%). Malting did increase the bio-accessibility of manganese from wheat (42%). Thus malting could be an appropriate food-based strategy to derive iron and other minerals maximally from food grains (Platel et al 2010). Malting and fermentation significantly decreased gruel viscosities leading to improved nutrient density. There was also significant reduction in packed bulk density and swelling index while water absorption capacity and reconstitution index increased (Gernah et al 2012).

**Weaning foods**

Suhasini and Malleshi (2003) prepared weaning foods based on malted wheat and chickpea (MWF), popped wheat and chickpea (PWF) and roller dried wheat and chickpea (RWF). The PWF and RWF were blended with 5 per cent barley malt flour to formulate low bulk popped (PWFM) and roller dried (RWFM) foods. The amino acid contents, carbohydrate fractionation, pasting characteristics and in vivo carbohydrate digestibility of the foods were determined. Also the liver characteristics of weanling rats fed on the foods were assessed. The foods contained 17.0-18.3 per cent protein, 1.7-3.7 per cent fat, 67.1-67.5 per cent available carbohydrates and 11.1-12.0 per cent dietary fibre. The lysine content of the food proteins ranged from 4.2 to 4.6 per cent. No appreciable difference in the amino acid contents among the different foods and also between the low bulk popped and roller dried foods (PWFM and RWFM) and their high bulk counterparts (PWF and RWF) were observed. These observations show that blending about 5 per cent cereal malt with high bulk weaning foods has advantages with respect to reduction in the dietary bulk by partial hydrolysis of carbohydrates but does not alter their amino acid content significantly.

Srivastava et al (2015) developed value-added weaning food using germinated cereals and pulses flour to assess its organoleptic quality as well as nutritional composition of prepared product. The flour (wheat, bajra and whole mung flour) were mixed in different proportions [T1 (60:20:20), T2 (20:70:10) and T3 (20:15:65)] to prepare sweet porridge. The results showed that T3 scored best in overall acceptability. The nutritional composition of product indicated that carbohydrate, energy and protein increased with germination. Though protein value decreased in T1 and T3 in the developed products but it increased in T2 showing overall best results. Hence it was concluded that germinated grain flour could be suitably incorporated in weaning food product. Germinated flour provided concentrated form of nutrients (carbohydrates, energy and protein) in comparison to normal flour. Table 1 shows the composition of germinated and non-germinated grain flours. The nutrients and minerals increased simultaneously in germinated grain flour.

Naltress et al (1988) investigated the feasibility of using germinated wheat, millet, garbanzo bean, mung bean and sesame in the proportion of 8:4:3:1. They found that the product was acceptable when it was served with banana and brown sugar. It contained 18 g protein, 1.1 g fibre and 3.1, 5.5, 13.3 and 29 mg of zinc, iron, calcium and vitamin C per 100 g respectively on dry weight basis. They reported that the product developed contained 60 per cent less phytate of that of non-germinated mixture.

Baskaran et al (1999) developed eight types of supplementary foods based on popped cereals (wheat, ragi, bajra and sorghum) blended with legumes (soya and Bengal gram). Organoleptic evaluation and feeding traits revealed that the foods were well accepted by rural mothers and children.

George (1991) reported that the malted wheat, maize, bajra, Bengal gram and jowar were found to contain good amount of protein, mineral elements such as iron and other essential nutrients. Therefore they could be utilized for supplementation purpose among these different types of malts. The malts prepared could be used in the development of weaning foods and other

Table 1. Comparison between constituents of germinated and non-germinated flours (g/100 g)

| Nutrient | Non-germinated flours | | | Germinated flours | | |
|---|---|---|---|---|---|---|
| | WF | BF | MF | WF | BF | MF |
| Protein (g) | 12.1 | 11.6 | 24 | 16.4 | 13.9 | 4.9 |
| Carbohydrate (g) | 71.2 | 67.5 | 56.7 | 86.4 | 79.2 | 70.1 |
| Calcium (mg) | 41 | 42 | 75 | 56 | 58 | 98 |
| Iron (mg) | 5.3 | 8 | 3.9 | 7.2 | 9.8 | 4.8 |

WF= Wheat flour, BF= Bajra flour, MF= Mung flour

types of ready to eat snack foods both for infants and children.

Gahlawat and Sehgal (1994) evaluated the shelf-life and nutritional values of four weaning foods made with wheat, barley, green gram and jaggery. Cereals, pulses and jaggery were blended in a 70:30:25 ratio after malting and roasting of grains. The four weaning foods had nutrient compositions within the range prescribed by the BIS for processed weaning foods. The weaning foods were packaged in polyethylene bags and stored at a temperature of 25-30°C at RH level of 70-80 per cent for 60 days to study the keeping quality. During the storage period the shelf-life was monitored by assessing degraded protein and acid value of fat. Proteolytic and lipolytic changes increased progressively with increasing storage. Malted weaning foods had higher acid values than roasted foods. All weaning foods were judged acceptable for consumption even after 60 days of storage.

**Problems and prospects**

Gluten is the main protein found in wheat and a few other grains like rye, spelt and barley. This protein gives dough its elastic properties and makes it pliable. The problem with modern wheat is that many people are unable to properly digest the gluten in it which causes celiac disease, a serious disease which may affect up to 1 per cent of the population (Sabatino and Corazza 2009). There are studies in people who don't have celiac disease showing that gluten can damage the intestinal lining and cause symptoms like pain, anemia, bloating, stool inconsistency, tiredness etc (Biesiekierski et al 2011).

A substance in wheat called phytic acid can bind minerals like calcium, zinc, iron and magnesium and prevent them from being absorbed. Whole wheat contains even more phytic acid than refined wheat (Febles et al 2002). The food product developed by germinated wheat contained 60 per cent less phytate of that of non-germinated mixture.

When blending about 5 per cent cereal malt with high bulk weaning foods has advantages with respect to reduction in the dietary bulk by partial hydrolysis of carbohydrates but does not alter their amino acid content significantly. Malting and fermentation significantly decreases gruel viscosities leading to improved nutrient density which is also best desired for infants feed.

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