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Nutrient Profile of Fermented Oats

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Abstract
A key component of well-being and healthy lifestyle is healthy food. Oats is recognised as a healthy food including a rich protein content of higher biological value, a greater proportion of unsaturated fatty acids, a high dietary soluble fibre (beta-glucan), insoluble fibre and micronutrients such as vitamin E, thiamine, folate, zinc, phosphorus, iron, potassium, copper and magnesium. The aim of the study was to identify the nutrient profile of oats fermented with *Lactobacillus acidophilus*. The fermented oats were evaluated as a significant amount of macronutrients such as carbohydrate, protein, fat, fibre and micronutrients such as biotin, folate, vitamin B1, vitamin B2, vitamin B6, vitamin E, niacinamide, vitamin K and choline and amino acids such as aspartic acid, glutamic acid, asparagines, serine, glutamine, glycine, threonine, taurine, arginine, alanine, cysteine, tyrosine, histidine, valine, methionine, isoleucine, phenylanine, leucine, lysine, proline and tryptophan.

Keywords: oats, fermentation, macronutrient, micronutrient and amino acids

1. Introduction
Nutrients are components in foods that an organism uses to survive and grow. Macronutrients provide the bulk energy an organism's metabolic system needs to function while micronutrients (vitamins and minerals) play a central part in metabolism and in the maintenance of tissue [6 and 22]. Oats has a distinctive nutritional profile compared with other types of grain, including protein with high biological value, unsaturated fatty acids, a high soluble (beta-glucan) and insoluble fibre, micronutrients such as iron, potassium, copper and magnesium, thiamine, folate, zinc and phosphorus [18].

Oats has low carbohydrate content compared to other cereals. Carbohydrate content of oats is 66gm/100gm [19]. Oats is a rich source of both soluble and in soluble fibre. Fiber represents six to nine per cent of the oat grain, half of which is the soluble fiber, beta glucans. Beta-glucans is proven to have multiple functional and bioactive properties [7]. Oats contain a high percentage of protein and balanced composition of amino acids. Highest protein content occurs in oat grout (12.4 to 24.5%) among cereals [5 and 15]. Amino acids (lysine, threonine, and methionine) content of oats are found to be greater than other cereals. Relatively higher concentrations of amino acids are present in the embryonic axis and scutellum rather than other portions of the kernels. Oats are unique among the other cereals for their high lipid content. Oats lipids are essential for human nutrition because they are rich in unsaturated fatty acids (linoleic acid and oleic acid) and essential fatty acids (myristic acid, palmitic acid, stearic acid). Lipids content of oats genotype is in the range of 3.1-11.6% [26].

Oats also contain a wealth of micronutrients such as thiamine, folate, biotin, riboflavin, niacin, iron, potassium, copper, magnesium, zinc and phosphorus. Folate (20-30 µg/ 100gm) and biotin (10-15 µg/100gm) content are higher in oats than other vitamins. Mineral content which is 2-3% in oat include phosphorus, potassium, magnesium, and calcium as main components as in other cereal [21]. Oats are rich in tocopherols which have antioxidant activities and contain about 2.3 mg tocopherols /100 gm grain [14].

Disease preventing functions of oats are mainly responsible for high nutrient profile. Consumption of oats helps to reduce weight, lower blood cholesterol level, improve postprandial glycemic and insulinemic responses in both non-insulin dependent diabetes mellitus and healthy subjects, boost immune system against bacteria, viruses, fungi, parasites and reduce the risk of colon cancer [16 and 10].

Fermentation can be defined as a desirable process of biochemical modification of primary food matrix brought about by microorganisms and their enzymes. Fermentation enriches foods biologically with protein, essential amino acids, essential fatty acids and vitamins. Fermentation of cereals leads to a general improvement in the shelf life, texture, taste and aroma, nutritional value and digestibility and significantly lowers the content of antinutrients of cereal products [11].

2. Materials and methods
Oats purchased from supermarket was cleaned to remove the impurities present in them. Then this was ground to a fine powder using a food processor and stored in air tight container at room temperature till further use. 1 gm of oats was mixed with 50ml of water in the ratio of 1:50 and it was autoclaved for 45 minutes. The same procedure was carried out for fermented oats to which 100µl of *Lactobacillus acidophilus* was added. Then the conical flask was plugged with cotton to keep insects and flies away. Fermentation was carried out for a period of 72 hours at room temperature.

2.1 Estimation of nutrient profile
Estimation of carbohydrate, protein, fat, fibre and amino acids were assessed according to standard methods described by [25, 12, 8 and 9]. Selected vitamins (vitamin B1, vitamin B2, vitamin B3, vitamin B5, vitamin B6, vitamin B9 and vitamin E) and minerals (zinc, magnesium, iron, sodium, phosphorus, calcium, manganese and copper) were performed according to standard methods described by [2, 20, 24, 17 and 8].

3. Result and Discussion

Fermentation of oats was carried out with 1:50 (1 gm of oats in 50 ml of water). So, 100 ml of developed sample contain 2 gm of oats. Nutrient content of fermented oats are tabulated in table 1 and table 2.

Table 1: Macronutrients and micronutrients content of fermented oats

Nutrients	Fermented oats (100 ml)
Macronutrients	
Carbohydrate	11.6113 gm
Fibre	2.67 gm
Protein	18.04 gm
Fat	6.79 gm
Micronutrients	
Vitamin B1	0.372 mg
Vitamin B2	0.1 mg
Vitamin B3	0.792 mg
Vitamin B5	3.132 mg
Vitamin B6	0.116 mg
Vitamin B7	12.88 mg
Vitamin B9	50 mg
Vitamin E	In trace
Zinc	2.6 mg
Magnesium	25.48 mg
Iron	0.772 mg
Sodium	0.54 mg
Phosphorus	83.6 mg
Calcium	9.84 mg
Manganese	5.32 mcg
Copper	0.84 mcg

Table 2: Amino acid profile of fermented oats

Amino Acid	Fermented oats (100 ml)
Aspartic Acid	124.6 mg
Glutamic Acid	403.5 mg
Asparagine	10.50 mg
Serine	Nil
Glutamine	Nil
Glycine	10.60 mg
Threonine	61.5 mg
Taurine	0.001 mg
Arginine	106.60 mg
Alanine	89.40 mg
Cysteine	45.60 mg
Tyrosine	49.5 mg
Histidine	51.7 mg
Valine	39.5 mg
Methionine	56.7 mg
Iso Leucine	78.4 mg
Phenylanine	12.4 mg
Leucine	145.6 mg
Lysine	89.3 mg
Proline	156.7 mg
Tryptophan	98.4 mg

From the table 1 it is stated that carbohydrate, fibre, protein, fat, vitamin B5, vitamin B7, vitamin B9, magnesium, iron, phosphorus and calcium were present significant amount in fermented oats.

From table 2, it is evident that aspartic acid, glutamic acid, asparagines, glycine, threonine, arginine, alanine, cysteine, tyrosine, histidine, valine, methionine, isoleucine, phenylanine, leucine, lysine, proline and tryptophan were present significant amount in fermented oats.

Microbial fermentation leads to a decrease in the level of carbohydrates as well as some non-digestible poly- and oligosaccharide which reduce side effects such as abdominal distention and flatulence. Improvement in starch digestibility during fermentation is due to break down of starch oligosaccharides. The enzymes bring about cleavage of amylase and amylopectin to maltose and glucose [11]. Fermentation of cereals by lactic acid bacteria has been reported to increase free amino acids. Fermentation has been shown to improve amino acids content (lysine, methionine and tryptophan) of grains such as wheat, rice, oats and corn which increase the protein content of cereals [23]. Fermentation enhances the fat content. This increases activity of the lipolytic enzymes during fermentation which hydrolyzes fat to glycerol and fatty acid. The basic fermentation process involves the enzymatic activities of lactobacilli, leuconostoc, pediococci, yeasts and moulds. Their metabolic activities result in the production of short chain fatty acids such as lactic, acetic, butyric, formic and propionic acids [1].

B group vitamins normally present in cereals-derived products, are easily removed or destroyed during milling, food processing or cooking. Lactic acid bacteria (LAB) can improve B vitamins in cereals during fermentation. Lactic acid bacteria increase synthesis of vitamin B2, vitamin B9, vitamin B11 and vitamin B12 [6]. Fermentation provides optimum pH conditions for enzymatic degradation of phytate which is present in cereals in the form of complexes with polyvalent cations such as iron, zinc, calcium, magnesium and proteins. Enzymatic degradation reduces the amount of phytate which may increase the amount of soluble iron, zinc, calcium several folds [13 and 14].

4. Conclusion

The present study conclusively demonstrates that fermented oats is a good source of carbohydrate, protein, fat, fibre, amino acids, vitamins and minerals. Fermented oats is a functional food; not only because of potential nutrients but also the *Lactobacillus acidophilus* present has many beneficial effects on gut. Fermented oats is easy to digest with an increased availability both of micro and macronutrient with help to control blood cholesterol and blood sugar level and prevent cancer. An increased awareness of the health benefit of fermented oats could reduce the risk of avoid variety of metabolic disorders and promote health.

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