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Review Article

EFFECT OF PROCESSING CONDITIONS ON THE QUALITY OF WHEAT PROTEIN

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Abstract

Wheat protein determines the biochemical and rheological properties of most wheat products. The final product depends critically upon the balance between different ratios of proteins that interact with each other through various processing methodologies. Protein is the most substantial component of our intake. As we belong to Asia, wheat is enriched source of protein for us. Large amount of proteins are found in wheat grain as compared to wheat flour. Wheat grains is transformed into variety of food products by enduring various food processing techniques. Nutritional quality is been negatively correlated by milling. Cell wall lysing in this process inflate the nutrients whereas it result in polysaccharide by stripping off wheat nutritional layers. Solubility of wheat protein rises through mixing which is further essential in dough kneading. Structural and functional properties of proteins is affected upon heating. Proteins became denature through heating and shearing during extrusion.

1. Introduction:

In Asian diet, cereals are considered as chief food. Whole cereal grains contain more nutrients than processed ones. Whole grains are subjected to dehulling, milling, refining, polishing, etc. for making useful products for industry. Some cereal grains are processed into flour before usage. These processes change the nutritional status of grains. Processing also alters the nutrient availability of grains(Oghbaei and Prakash, 2016(a)). For over 8500 years, Wheat (*Triticum*spp.) has been consumed by humans and currently it supplies about 20% of global dietary protein (Braun, Atlin and Payne, 2010)

Wheat is a cereal grain, its use depends upon amount of protein present in it (Bushuk, 1992). Wheat gluten is the most important cereal protein on which the functional properties of product depends (Hoseney and Rogers, 1990). Osborne, renowned food scientist, segregate gluten into two proportions, gliadin which is soluble in alcohol, and glutenin which not soluble in alcohol but soluble in dilute acid or alkali (Wrigley and Bietz, 1988). Gliadin and glutenin present in wheat flour interact with one another by addition of water and form gluten (Bloksma, 1990).

Wheat quality can be explain by considering wheat protein structure and effect of processing on wheat protein (Hayta and Alpaslan, 2001(a)). This article aims to review the effect of processing (mixing, sheeting, heating, drying, etc.) on wheat protein (solubility, elasticity, denaturation, etc.).

2. Wheat Proteins:

There are three main types into which wheat proteins are classified. These three types are called gluten, globulin, and albumin. For developing seedlings nitrogen is provided by gluten and other specific functions like enzymes inhibition, enzyme synthesis and structural changes are perform by albumins and globulins. Gluten is made up of water insoluble wheat proteins: gliadin and glutenin. Proline and glutamine are amino acid which are the rich constituents of gliadin. Proline is hydrophobic and thus it is bulky due to this it is responsible for giving flow and rise to dough. Glutenin proteins are polymer and is responsible for maintaining the shape of wheat products like bread (Kucek et al., 2015).

3. Milling:

It is a process in which grains are converted into flour or meal by the help of grinder (Bender, 2006).This process is of two types. One in which grains are grinded to flour without sieving any part e.g. whole wheat flour. Second in which grains are grinded and sieve according to their size into different fractions e.g. refined wheat flour, bran, germ and semolina etc. (Oghbaei and Prakash, 2016 (b)). Milling is an important process which aims to discard the husk and sometimes bran layer leaving behind eatable portion in the form powder which is free from unwholesome particles. By increasing the degree of milling, the concentration of nutrients decreases (Ramberg and McAnalley, 2002(a)). Many staple foods such as different bread varieties are prepared from milled wheat (Edward, W.P. 2007) flour produced as a result of milling has less nutrients as compared to wheat grain. Flour has seventy percent less minerals and vitamins, about twenty-five percent less proteins (Ramberg and McAnalley, 2002(b); Ready and Love, 1999).Although, milling decrease nutrients through separation of bran but it improves the starch digestibility.

4. Mixing:

It is a technique use to incorporate all the ingredients in such a way so as to make the product uniform. Properties of dough and quality to make bread, all depend upon duration of mixing. This shows that practical effects of wheat proteins can be change through mixing. Protein contain disulphide, hydrogen and hydrophobic bonds that effect its dissolving power (Feillet, 1988). It is widely known that mixing increase the protein dissolving power. Mixing reduce the size of protein molecules because it causes depolymerization and disaggregation of them. It reveals that mixing is time dependent, more mixing more protein dissolves and vice versa (Tanaka and Bushuk, 1973).

5. Heating:

It is a preservation technique, in which moisture of grains is removed by applying temperature of 130 to 150 degree centigrade for 20 minutes. Germ proteins of wheat have similar essential amino acid to an egg, which make it best between vegetable proteins (Miladi and Hegested, 1972). The nutritional status of wheat germ is similar to that of animal protein (Hove and Harrel, 1943). Wheat germ also has high amount of unsaturated fatty acid which affects its properties. As a result, wheat is subjected to roasting and drying(Jurkovic and Colic, 1993). Dried germ of wheat grain have the same characteristics of raw germ of wheat grain that is why it is used for making heat treated food e.g. bread, rolls, buns and cookies, etc. Enhance taste and aroma of roasted grains allow this to be use as accessory or food improver in different products e.g. cakes, stuffing etc. (Rand and Collins, 1958).

Heat will affect the solubility, rheology, conformation, interfacial behavior, gel electrophoresis of protein (Slade and Levine, 1995). Protein dissolving power drop down with temperature elevation but omega gliadin are unaffected by heat treatment (Schofield et al., 1983). Heat affect the rheological properties of proteins in such a way that at temperature of forty degree centigrade or above this causes irreversible chemical alteration (Lefebvre, et al., 2000;Tsiami, et al., 1997). Temperature higher than this affects the elastic properties (LeGrys, et al., 1981; He and R. C, 1991) and decrease the compressibility power of gluten (Jeanjean, R and P, 1980). Wheat proteins are thermally denatured and their molecular weight increases (Cuq et al., 2000) due to randomization and polymerization of sulfhydryl and disulphide exchange reactions (Weegels et al., 1994;Autran, O and P, 1989). As a result there is less hydrogen bonding but more hydrophobicity in wheat protein (Tatham et al., 1987).

6. Extrusion:

It is a technique used to make ready to eat cereals and snacks with alternate swelling properties (Fischer, 2004(a)). Extrudates are the products of extrusion cooking, wheat gluten play role in microstructural and textural formation of extrudates (Faubion and Hoseney, 1982). Extrusion causes protein aggregation due to intermolecular disulphide bonding (Li and Lee, 1996). During extrusion, application of temperature and moisture affect the protein polymerization. When the material leaves the extruder it loose moisture suddenly and due to this wheat proteins becomes frozen (Fischer, 2004(b)). The structure of protein is very important because the properties of the end products depends on it (Shulka, 1996). Extrusion makes the wheat protein insoluble due to heat and shear applications. It also affect the secondary structure of protein through oxidation and reduction reactions (Stanley, 1989;Camire and Amer, 1991). Among all the wheat proteins, gliadin are most affected while glutenin are least affected (Hayta and Alpaslan, 2001).

7. Conclusion:

Protein is the most significant constituent of our diet. As we are Asian, we use to accomplish our protein necessity through wheat. Wheat grain has enormous protein as compared to wheat flour. Wheat grains undergo number of processing techniques which facilitates their use in making variety food products.

Milling has complementary effect on the nutritional quality. It elevate the nutrients by cell wall lysis whereas it peels off the nutritive layers of wheat leaving behind polysaccharide. Mixing enhance the solubility of wheat proteins by reducing its size which is further suitable for dough making. Heat affects the structural and functional properties of proteins. During extrusion, through heat and shear application, proteins are denatured.

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