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IMPACT OF TYPE AND PARTICLE SIZE ON THE PROTEIN CONTENTS IN WHEAT FLOUR

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Abstract

Two main types of wheat flours that are fine and branded flours used in Khyber Pakhtunkhwa, Pakistan, were analysed for their particle size. Sieve analysis was carried out which gave eight samples of different particle sizes, divided into fractions and ranged from 63-100, 100-250, 250-350 and larger than 350 µm. All the four sizes of the each flour type were analysed for their protein content, using Kjeldahl method by Kjeltec-1002 apparatus. The results showed that more proteins (11.8%) were recorded in fine flour as compared to (11.3%) in branded flour. Also it was observed that reducing the size from 350 µm to 63 µm caused 13% protein loss in branded wheat flour and 11% in fine flour. It was concluded that wheat flour with particle size smaller than 350-250 µm significantly lost its protein content. So it is recommended to grind wheat in such a way that the particle size remains greater than 250 µm.

Keywords: Branded, Fine, Particle size, Proteins, Wheat flour.

Introduction

Milling requirements of more than 80% countries for wheat is being done using conventional Burr mill operated by engines or electric motors. For grinding of wheat, flour mills fitted with cast iron steel plates and emery stones have successfully replaced the old traditional red stoned discs mills all over the world, especially, in South Asia (Ramappa et al., 2011). In Pakistan, beside Burr mills, which are on large scale, small mills of conventional types are still used in good number both in urban and rural areas but the overall efficiency of these mills was found to be very poor which results in low quality of flour (Dorosh and Salam, 2008). In the past decade technology has became very advanced by the development of new mills for grinding of wheat grains in which cast iron steel plates are present for grinding and sharing on which the radial grooves of different shapes running from the center of the plate to the periphery have significantly improved the milling performance of wheat and have improved the quality of wheat flour (Banu, 2011).

The size of ground wheat flour is the most important parameter judging the quality of the flour as it is directly related with the protein content, digestibility, N-balance as well as the cost. Fine flour costs more due to uniform particle size as compared to the branded flour (Majzoobi et al., 2012). Sometimes milling of wheat in not done efficiently which has a direct impact on the quality as well as the cost of flour. Such inefficiencies arise due to inability to produce uniform grinding of the wheat grains and the time taken to crush the material to the required size of the screen as in the mill. The grade of grinding depends on the fineness within each mill. The size of flour must be in the range of 250 µm and 360 µm to achieve high digestibility from the cooked product (Yawatkar et al., 2010).

Laurinen et al. (2000) studied the digestibility of all cereal grains and studied that finely ground cereals are dusty and they may induce respiratory diseases. Moreover, small grist size is one of the main causes of gastric lesions. They concluded that the particle size of wheat flour of less than 150 µm and larger than 350 µm adversely affects its protein contents as well as its digestibility. Potkins et al. (1989) and Alaviuhkola et al. (1993) reported that coarse grinding of wheat flour having size more than 350 µm and less than 150 µm may impair essential nutrients like proteins. Sauer et al. (1977) studied that flour type and practical size have direct correlation with the protein content of flour. Nwaigwe et al. (2012) reported that finely ground wheat flour is best for making biscuits, breads and standard bakery cakes with high protein contents as compared to coarsely ground and branded wheat flour.

The aim of the experiments was to analyse the particle size of the two main types of wheat flours (i.e. fine and branded) used in Khyber Pakhtunkhwa and to see the effect of the analysed particle sizes on the protein content of each flour type.

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Materials and Methods

Sieve analysis: Retsch Vibratory Sieve Shaker AS450 basic with 9 pans and a range of 20 µm to 25 mm with capacity of 3 kg was used in the experiment. The analysis was done following the procedure reported by AACC (2000).

Fineness modulus: It is defined as an empirical figure obtained by adding the total percentage of the sample of an aggregate retained on each of a specified series of sieves, and dividing the sum by 100. The smaller the value of FM indicates the finer size of grind of a material. FM for each flour sample is calculated using the formula given by Ramappa et al. (2011).

Experimental procedure: The two main flour samples were collected from more than ten different commercial flour mill bags available in the local market. Both the flour types give 8 samples of different practical size, divided into fractions, ranging from 63-100, 100-250, 250-350 and larger than 350 µm. All the eight samples were digested, using sulphuric acid (concentrated, 95–98%) with catalyst and the nitrogen contained in the sample was converted to ammonia; ammonium sulphate being formed which was analysed, using Kjeldahl method by Kjeltec 1002 apparatus following the procedure of AOAC given by Williams (1984) to find the crude proteins in each sample.

Statistical analysis: All the samples were taken as treatments with flour type as a major factor and flour size as a minor factor. Analysis of variance test was applied to find out whether the data was significantly different from each other or not. Mean comparison was done after ANOVA test using Duncan's Multiple Range Test.

Results and Discussion

Particle size distribution

The granulometry profile of both the main flour types is given in Table 1. Most of the particle sizes lie in the range of 100 to 250 µm. Almost 70% of the branded and 66% of fine flour lies in this range. This shows that most of the flour of each type of each mill has 60-70% flour size in the range of 100-250µm. The results of particle size distribution are in accordance with the sizes used in experiments by Chiotelli and Meste (2002), Ramappa et al. (2011), Blanchard et al. (2012) and Justin (2012).

The impact of type and particle size on the protein content of both the flour types is shown in Table 2. The analysis of variance showed that protein content was significantly affected by particle size distribution. The protein contents in both the flour fractions differed as a function of the particle size range. The smaller the size of part icle, the lower was the protein content of that flour. More proteins at average of 11.8% were recorded in fine flour as compared to 11.3% recorded in branded wheat flour. Compared to other fractions, the lowest protein content as a total was observed in flours with particle size 63 µm. There was a total of 31.1% decrease recorded in proteins in branded flour when its size reduced from 350 µm to 63 µm. Similarly 31.9% decrease was recorded in fine flour. These results are in accordance with the findings of Blanchard et al. (2012) who reported that wheat flour with particle size smaller than 50 µm had minimal proteins in it. The results are also in agreement with those of Chiotelli and Meste (2002), who reported that flour size smaller than 250 µm resulted in significant decrease of protein content of

Table. 1. Granulometry profile of both flour types.

Sieve size (µm)	Cumulative percent retained		Reported percent passing	
	Branded flour	Fine flour	Branded flour	Fine flour
350	22.5	18.6	77.5	81.4
250	27.2	33.9	50.3	47.5
100	42.7	35.4	7.6	12.1
63	6.2	13.8	1.4	17.9
Pan	1.1	18.6	0	0

Modulus of finesse for fine wheat flour = 2.7 and for branded wheat flour = 3.5

Table. 2. Impact of type and particle size on the protein content of wheat flour.

Particle size (µm)	Protein (%)		CD (%)
	Branded flour	Fine flour	
350	13.2a	14.1a	6.3
250	12.3b	12.7b	3.1
100	10.7b	10.8c	0.9
63	9.1c	9.6c	5.2
Mean	11.3b	11.8a	

LSD = 0.13

dough. Curic et al. (2001) also reported the same results that particle size lower than 250 µm reduced Gluten (protein) content of wheat flour. Majzoobi et al. (2012) reported that good quality proteins like albumin and globulins were destroyed due to reduction in the particle size. Decreasing the size of wheat flour directly decrease the proteins in it so it is recommended for wheat flour to have particle size within range of 450-750 µm.

Conclusion and Recommendation

The study concluded that wheat flour with particle size lower than 350-250 µm has significantly lost its protein content. Fine wheat flour was found to have higher proteins than branded flour. It is, therefore, recommended to grind wheat in such a way that the particle size remains in the range of 350-250 µm otherwise significant protein loss would occur on grinding to very fine size.

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