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Full Length Research Paper

The quality characteristics of four subfractions of wheat flour in Qinghai-Tibet Plateau

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To investigate the quality characteristics of different size of flour particle in Qinghai-Tibet Plateau, coarse flours from twelve spring wheat varieties were sifted with sieves of 150, 75 and 44 µm. Four subfractions and the coarse flour were evaluated for protein content, ash content, protein components, and rheological properties. Mean weight percentages of >150, 75-150, 44 to 75 and <44 µm subfractions were 43.8, 37.4, 14.4 and 4.5%, respectively. The different size of flour particle had different quality characteristics. Subfraction <44 µm had the lowest protein content. 44 to 75 µm had the highest protein content, gliadin content and globulin content. It also had relatively high glutenin content. Therefore, it had the biggest SDS sedimentation value. Although subfraction >150 µm had the highest glutenin content, its SDS sedimentation value was the lowest, and its rheological properties were worse than the coarse flour and 75 to 150 µm. This indicated that big particles were not conducive to formation of nice dough.

Key words: Wheat, granularity, subfraction, quality.

INTRODUCTION

In wheat grain, there are many kinds of chemical components, such as protein, amino acid, carbohydrate, fat, mineral substances and so on, and these compounds distribute in different parts of the grain and do difference to wheat quality. Protein was recognized as the most important component determining the bread-making quality of wheat flour (Schofield and Booth, 1983; Wrigley and Bietz, 1988; Schofield, 1994). There are four classes of proteins in wheat grain: Albumen, globulin, gliadin and glutenin. Albumen and globulin take part in metabolism, gliadin and glutenin are storage proteins, which contribute directly to the rheological properties of dough (Khatkar et al., 1995) and bread-making performance (Khelifi and Branlard, 1992; Khatkar, 2002). Gliadin imparts essentially viscous property, whereas glutenin exhibits viscoelastic property to dough (Cornec et al., 1994; Khatkar et al., 1995). It is well known that gliadin and glutenin dwell in endosperm, but it is not known whether they distribute in the same pattern or not. Previous researchers have done a lot of work about subfractions of wheat flour and chemical components of subfractions, but protein components and their rheological properties were not taken into consideration. Another limitation is that only <44 µm subfraction was taken as the experimental emphasis (Jones et al., 1959).

The Qinghai-Tibet Plateau is one of wheat high-yielding regions, and a high yield record of 15196 kg/ha has been created with spring wheat variety Plateau 338 developed by Northwest Institute of Plateau Biology, Chinese Academy of Sciences. But the wheat was not good for bread-making, and the quality characteristic of different subfractions of the wheat flour has not been clarified in this region. In this article, we investigate the qualities of four subfractions of flour in this region. The objective of this study is to know more about the quality of flour and

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the relation between particle size and flour quality in the and processing by grain milling technology.

MATERIALS AND METHODS

Twelve spring wheat varieties (strains) were selected from the Qinghai Provincial Spring Wheat variety Trials. They were Qingchun533 (QC533), 001000, 99-18, 99096, 01-225, Ganchun20 (GC20), 99-22, 99-36, 99-88, 99605, Liaochun13 (LC13) and Xiaobingmai33 (XBM33). QC533 was used as the control in the trials in Qinghai Province of P. R. China. GC20, LC13 and XBM33 are bread wheat cultivars introduced from Gansu, Liaoning and Jilin Provinces of P. R. China, respectively. The other entries were strains newly developed in Qinghai Province, P. R. China. In 2004, these varieties were grown in triplicate under identical conditions at Ping'an Eco-agriculture Station, NWIPB, CAS, which located in the northeast of the Qinghai-Tibet Plateau. The varieties were harvested and bulked in variety. Wheat grains were tempered for 12 h on the basis of 14% moisture and then milled in a quadrumate junior mill (C. W. Brabender, Germany). The white flours were sifted on 150, 75 and 44 µm sample sieves for five minutes in turn. Four subfractions (>150, 74 to 150 , 44 to 75 and <44 µm) were obtained.

SDS sedimentation volume was measured in duplicate in CIMMYT method with 1.000 g flour sample (Xu, 2000). Farinograph values were determined in AACC method 54-21 (2000) on a Farinograh 820604 (C. W. Brabender, Germany). Protein content, ash content, granularity and moisture of the samples were determined in duplicate on a dry weight basis on a near-infrared spectroscopy (Model 8600, Perten).

Protein component measurement: 0.500 g sample from each grade of flour was weighed in a centrifugal tube and 6.5 ml 40% isopropylalcohol was added into the tube. It was shaken up adequately on a shaker for 12 h and then centrifuged with 3000 rpm for 20 min. The upper clear fluid was collected for gliadin. And then 6.5 ml 2%HCl was added into the tube. It was shaken up for 4h and centrifuged for albumin. The above process was repeated with 3.85% lactic acid and 4 h for globulin, 0.5% NaOH and 12 h for glutenin, respectively. Contents of protein components in the clear fluids were measured in duplicate at 280 nm on a UV-VIS spectrophotometer 755B made in P. R. China. The data was analyzed with excel 2000.

RESULTS

Weight and granularity

Average weight percentages of >150, 75 to 150, 44 to 75 and <44 µm subfractions were 43.8, 37.4, 14.4 and 4.5%, respectively (Figure 1A), which were similar to the results of Kim (2004). Granularity of each subfraction for each variety was showed in Figure 1B. Granularity of >150 µm was the highest and < 44 µm was the lowest. Granularity decreased as flour particle size (from >150 to < 44 µm). It could be concluded that sifting was suitable for classifying white flour particles.

Ash and protein content

Average ash content declined from <44 to 75-150 µm (Figure 1C). Generally speaking, >150 and <44 µm were the highest in ash content (0.83%) and 75 to 150 µm was the lowest (0.75%) (Figure 1C). Protein content of <44 µm was the lowest, which was the same as the previous researches (Xu, 2000). Protein content of 44 to 75 µm was the highest (13.87%) (Figure 1D).

Protein components

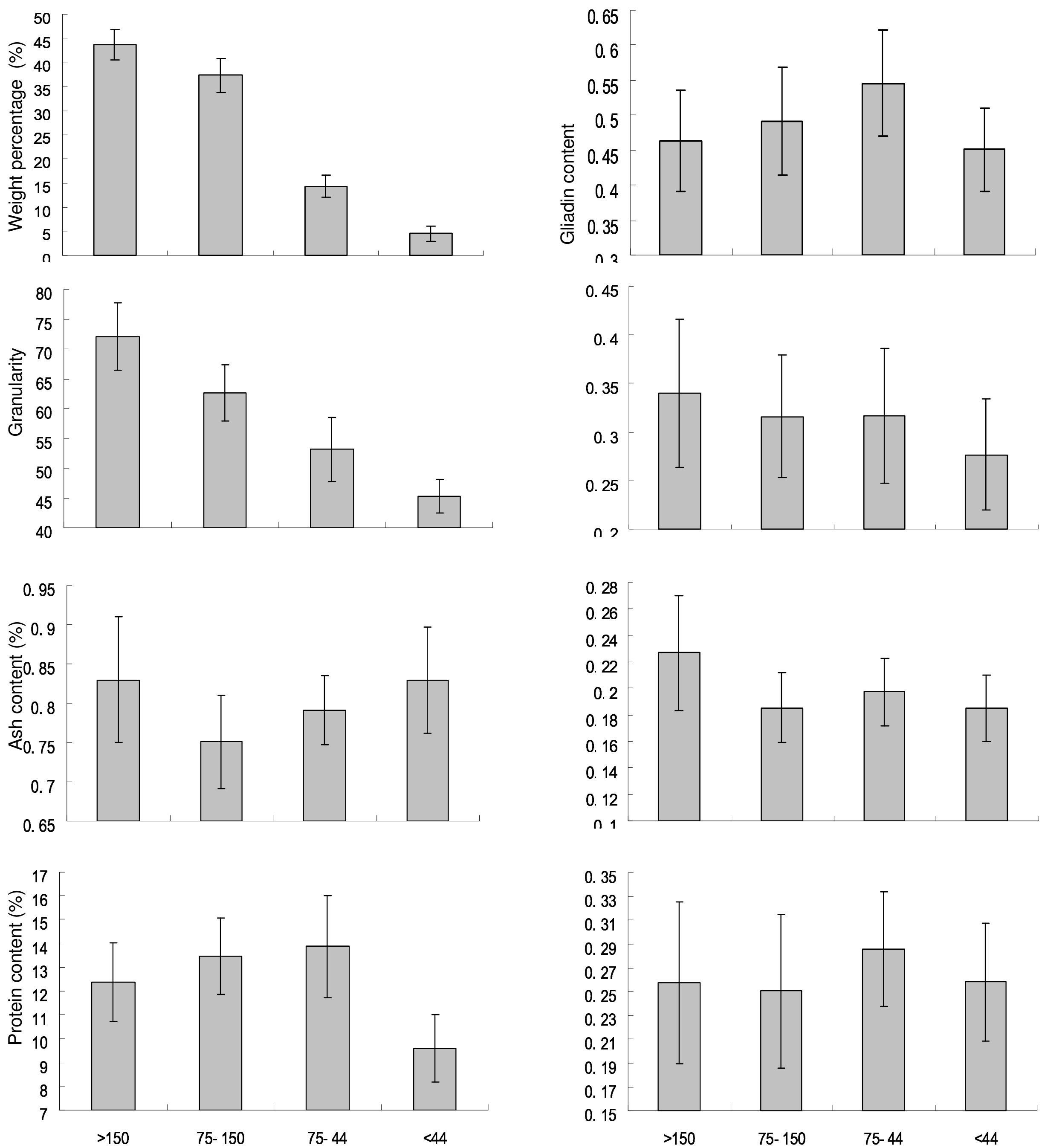
Contents of four classes of proteins varied among the subfractions. Gliadin content was the highest in 44 to 75 µm (Figure 1E), which distributed the same as total protein content. Subfraction >150 µm had an apex of glutenin content (Figure 1F). The distributions of glutenin and gliadin were the same as our result of SDS-PAGE (unpublished). There were two apices of albumin content: >150 and 44-75 µm (Figure 1G), and globulin distribution was complex (Figure 1H). Distributions of four classes of proteins were different to each other in subfractions. It indicated that four classes of proteins distributed uneven in grain and the four classes of proteins might make different contributions to the interaction of starch–protein.

SDS sedimentation and rheological properties

It was showed that change trend of SDS-sedimentation value were the same as protein content in these subfractions (Figure 2). The maximum value (18.28 ml) appeared in 44 to 75 µm. For the shortage of material, the coarse flour, only subfraction >150 µm and subfraction 75 to 150 µm were tested for rheological properties on fainograph. The changes of farinograph parameters were the same among the varieties, so the data was listed with mean values of farinograph parameters. It was showed that farinograph parameters of the coarse flour were between >150 and 75-150 µm, and farinograph parameters of 75 to 150 µm were better than >150 µm (Table 1).

DISCUSSION

Flour with different particle size had different protein content, different protein composition of the fractions and other quality characteristics. Subfraction <44 µm had the lowest protein content. Because size range of wheat starch particles was 3 to 34 µm (Buttronse, 1960; Mary, 1985; Morris, 1994), subfraction <44 µm consisted mainly of wheat starch particles. That was the reason why it had the lowest protein content. Particles of >44 µm should be compounds of starch particles and protein. Subfraction 44 to 75 µm had the highest protein content, gliadian content and globulin content. It also had relatively high glutenin content. Therefore the subfraction had the highest SDS sedimentation value. Although subfraction >150 µm had


Weight percentage (%)
Gliadin content
Granularity
Ash content (%)
Protein content (%)
>150
75- 150
75- 44
<44
>150
75- 150
75- 44
<44

```
ERROR: rangecheck
OFFENDING COMMAND: .buildcmap

STACK:

-dictionary-
/WinCharSetFFFF-V2TT9BF4ACCAt
/CMap
-dictionary-
/WinCharSetFFFF-V2TT9BF4ACCAt
```