

Original Research Article

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Evaluation and Comparison between Physical and Chemical Properties of Two Variety Wheat

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ABSTRACT

The present study was aimed to evaluate and compare the physical and chemical properties of the two varieties of wheat which were sharbati variety and lokwan variety and also evaluating and comparing the physical and chemical properties of the flours (maida, chakki atta, mill atta and semolina) obtained from the above two varieties of wheat. The properties tested for the wheat were hectoliter test, dimensional analysis of wheat kernel and the moisture content of the wheat and as for the flours sieve analysis, colour test, moisture content test, ash content test, gluten test and strength of the flour were tested to know about the physical and chemical properties of them. Evaluations were made between the physical and chemical properties which were evaluated by conventional and standard methods and comparisons were made between the two varieties of wheat and the flours obtained from them.

Keywords

Wheat, Sharbati wheat, Lokwan wheat, Maida, Semolina

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Introduction

Wheat

Wheat is one of the world's most important grains, with annual world production of about 600 million tons. Approximately 70% of wheat is used for food production. In Chhattisgarh, wheat occupies average of 3.6 million ha. with the productivity of the state ranging between 1.2 to 1.6 t/ha depending

upon the rainfall. Wheat is milled into maida, chakkiatta, mill atta and semolina which is then made into products such as bread, cakes, chapatti, macaroni and noodles. The miller has two main aims: first, to supply the customer with the specified product quality and second, to efficiently separate the endosperm from the bran. The flour yield and flour properties, among other things, are strongly related to wheat kernel properties, especially to the physical properties (Dariusz

Dziki, Janusz Laskowski, 2005).

Milling of wheat

Milling is the process by which cereal grains are ground into flour. Traditionally, and in some parts of the world to this day, this would have been accomplished by grinding the grain between two stones, a lower, stationary stone called the quern stone and an upper, mobile stone called the handstone (Mark Winfield). The four predominant techniques for grinding whole grain flours are stone mill (SM), roller mill (RM), ultra-fine mill (UM) and hammer mill (HM) (Kent and Evers, 1994). The hammer mill causes the product to be heated up and to lose moisture (Posner and Hibbs, 2005). Stone mills generate considerable heat due to friction, resulting in damage to starch, protein, and unsaturated fatty acids (Prabhasanka and Rao, 2001). The process of roller milling involves separation of the endosperm from the bran and germ followed by gradual size reduction of endosperm (Ziegler and Greer, 1971).

Physical and chemical properties of wheat and flours are grain size, color, moisture content and ash content. The grain length and grain thickness were significantly affected due to the differences in wheat varieties while grain width did not differ significantly among the wheat varieties. The thickness, width and height are measured with the help of electronic vernier caliper.

The ash content influences the colour of flours. (Hal'aszn'e *et al.*, 1995) proposed a qualification system based on the colour measurements of durum semolina. During the product manufacturing, the colour characteristics were mainly used to determine the appropriate roastedness (Hotti *et al.*, 2000). Determining moisture content is an essential first step in analysing wheat or flour quality since this data is used for other tests. Flour millers adjust the moisture in wheat to a

standard level before milling. Moisture content of 14 percent is commonly used as a conversion factor for other tests in which the results are affected by moisture content. Moisture is also an indicator of grain storability. Wheat or flour with high moisture content (greater than 14.5 percent) attracts mold, bacteria and insects, all of which cause deterioration during storage. The flour with moisture content in the range of 13-15% which is within the range for the effective storage of flour were studied (Whiteley, 1971). Moisture content of 12-15.5% has been specified for cereal flour storage. Failure to store flour under this conditions leads to moisture absorption from the atmosphere, which eventually leads to caking (Kent 1980). Moisture content of wheat is determined by hot air oven. The minerals in wheat grain are located mainly in its peripheral layers. The flours of high extraction containing the grain envelope part have higher ash content than flour from low extraction by the endosperm which is poorer in mineral substances. The value of ash content, in both wheat and especially in the flour is a basic quality index, differentiating the extraction flour types (Bordei *et al.*, 2007).

In this research study, evaluation and comparison of physical and chemical properties of two varieties are made between sharbati and lokwan variety which are the local wheat varieties of Madhya Pradesh, India.

Materials and Methods

This chapter deals with the various experiments and techniques used for the study of physical and chemical properties of wheat and the flour made from wheat. The testing was carried out in Grains Processing unit, Mahamara, Durg (C.G.).

Apparatus used

In this study, instruments/apparatus will be used for the study and comparisons of wheat and its flours i.e., digital vernier caliper, moisture meter, weighing machine, petri dish, desiccators, wooden scale crucible dish, hot air oven, sieve analysis apparatus, ash furnace, cooling dish, measuring scale, bread mould, mixing bowl, volume container.

Methods and procedure

Dimensional analysis of wheat

The length, width and thickness of nine different samples of wheat kernels were measured by using digital vernier caliper. The average of nine values was calculated to get the dimensions of wheat.

Hectolitremass of wheat

Fill the hopper of hectolitre with sharbati variety of wheat. Close the lid of the hectolitre. Remove the extra wheat by tilting the hectolitre. Now weight the wheat by using the electronic weighing machine. Repeat the above steps for lokwan variety of wheat.

Moisture test of wheat

Take volume A (fix volume of grain) of wheat and put it in moisture meter. Adjust the pressure of moisture meter to 462 on scale of moisture meter. Switch on the measuring button of moisture meter. After the beep sound the required moisture is displayed on the screen of moisture meter.

Color test

Take a small amount of flour and set it on wooden scale. Dip it in water for a second or two. Let it dry in room temperature. The color is determined by sensory analysis. The cracks

appeared on flour are also seen for quality check of flours.

Moisture test for flours

Take 10 gms of flour in petridish. Measure the weight of petridish and sample weight together for wet weight. Put the sample in hot air oven for 2 hrs at 130°C. Cool the sample in desiccator for 15 minutes. Now weight the sample and petridish for dry weight (WD).

Formula Used –

$$W_w - W_d = W$$

$$\frac{W \times 100}{10} = MC$$

Here,

W_w – Wet basis weight

W_d - Dry basis weight

MC - Moisture content (%)

Ash content test

Take a crucible dish and measure its weight (W_1). Take about 10 gms sample (W_2). Put the sample in crucible dish in furnace for about 6hrs at 600°C. Cool down the sample in desiccator for 15 minutes. Now weight the sample with crucible dish which will be the dry weight (W_3) Formula Used–

$$\frac{W_3 - W_1}{100 - MC} \times 10000 = A$$

$$\frac{A}{W_2} = AC\%$$

Here,

W_1 - Weight of crucible dish

W_2 - Weight of sample

W_3 - Weight of crucible dish and sample after drying

AC - Ash content (%)

Gluten test

Take 25 gm of sample flour. Add about 15 ml of water and make it into dough and give it a spherical shape. Dip the dough in water for about 1 hr. After 1 hr take out the dough and wash it with water. Dry it in room temperature for removing the extra water. Now weight it which will be the wet weight.

Formula used for wet basis

$$G_w \% = \frac{W_w \times 4}{3}$$

- i. Put it in oven for 2.5 hrs at 170° C on a paper.
- ii. Now weight the sample to get the dry weight (W_D) also weight the paper (W_P).
- iii. Multiply the dry weight with 4 to get the values for 100 gms of sample.

Formula Used –

$$\frac{W_D - W_P}{100 - MC} \times 10000 = B$$

$$\frac{B}{25} = G_D \%$$

Here,

W_W -Wet basis weight

W_D - Dry basis weight

W_P - Paper weight

G_W - Gluten content on wet basis (%)

G_D - Gluten content on dry basis (%)

Water absorption power

The amount of water required to make the dough for gluten is multiplied by 4 to get the water absorption power of flour for 100 gms. Expressed in terms of percentage(%). Water absorption power must be minimum 60% for an ideal flour.

Sieve analysis testing for purity

100 gms sample of flour is taken in uppermost sieve (sieve size as per the flour) of sieve analysis apparatus. 132 μ sieve size is kept below and is used for every flour. Set the timer for 5 min. After sieving the retained impurity is weighted.

Strength of maida

Take 300 gms sample of maida. Add 2% yeast, 4% sugar, 1% salt, 150 ml water, 3-4 gms oil. Mix the above ingredient and stand it for about 30 minutes. After 30 minutes quill the dough for 5 minutes. Coat the bread mould with oil. Put the dough in the mould and cover it with wet cloth. Rest it for about 1 hr. Now bake it in oven for 20-25 minutes at 250° C. Measure the rise with the measuring scale.

Results and Discussion

Physical and chemical properties of wheat

Dimensions of wheat

The length, width and thickness of three different samples of wheat kernels were measured by using digital vernier caliper. The length is measured from top to bottom of wheat kernel. The width is measured from the side to side portion of wheat kernel. The thickness is measured from the cut side and the side opposite to it. Table 1 shows the result after the measuring the dimensions from digital vernier caliper.

The length of sharbati wheat when measured by digital vernier caliper was found to be 6.055 mm, the breadth was 3.433 mm and thickness was 2.733 mm. It is almost the usual size of wheat which are popular these days. The length of lokwan wheat was to be 7.1 mm, breadth was found to be 3.411 mm

and thickness was 2.766 mm which is bigger in size as compared to the sharbati variety wheat.

Hectolitre test

Hectolitre mass, is a measure of the volume of grain per unit. It is usually expressed as kilograms per hectolitre and is a good indication of grain-soundness. Millers usually use test weight as an indication of expected flour yield. The factors affecting the hectolitre weight are kernel shape and uniformity of kernel size, orientation of kernels in container when it is filled, density of the grain influenced by structure of grain and its chemical composition. The results obtained from this test are shown in table 2.

The hectolitre mass of sharbati variety wheat was found to be 82 kg/hl and the hectolitre mass for lokwan variety was found to be 78 kg/hl. The difference in hectolitre mass occurred due to the density of grain and also the kernel size as lokwan variety wheat was a bit bigger in size as compared to the sharbati variety. The uniformity in kernel size was observed in both the samples of the two varieties thus the difference in hectolitre mass was not influenced by it.

Moisture content of wheat

The moisture of wheat is measured by two methods. Moisture meter and AACC International Approved Methods of Analysis of Moisture Air-Oven Method were used. There was a very difference in the moisture content obtained from the two methods but both are reliable for testing the moisture content of wheat. The result of the are shown in tabular form in Table 3.

The moisture content of wheat must range from 12% to 16%. The moisture content measured from moisture meter of sharbati

variety shows the moisture of about 15.61% while moisture obtained from air oven method is about 15.276% of same wheat variety. The moisture content measured from moisture meter of lokwan variety shows the moisture of about 14.108% while moisture obtained from air oven method is about 14.821 % of same wheat variety. The moisture obtained for lokwan variety wheat was less as compared to the sharbati variety wheat.

Physical and chemical properties of flours obtained from the two varieties

Sieve analysis for purity

The sieving is done as per the standard sieve sizes used for various flours obtained from the two varieties of wheat. The retained flours are given in grams as per the various sieve sizes. The results were shown in tabular form in Table 4.

Sharbati variety

From above table we can see that for sieve size of 150 μ , 0.052 gms of flour is retained and for 132 μ , 1.398 gms of flour is retained for maida I. For sieve size of 180 μ , 0.196gms of flour is retained and for 132 μ , 2.156gms of flour is retained for maida II.

For sieve size of 212 μ , 5.489gms of flour is retained and for 132 μ , 10.736gms of flour is retained for chakkiatta. For sieve size of 212 μ , 9.7 gms of flour is retained and for 132 μ , 60.472 gms of flour is retained for mill atta.

Lokwan variety

For sieve size of 150 μ , 0.079 gms of flour is retained and for 132 μ , 1.982gms of flour is retained for maida I. For sieve size of 180 μ , 0.250 gms of flour is retained and for 132 μ ,

2.413gms of flour is retained for maida II. For sieve size of 212 μ , 5.025gms of flour is retained and for 132 μ , 12.371gms of flour is retained for chakki atta.

For sieve size of 212 μ , 10.246 gms of flour is retained and for 132 μ , 62.002 gms of flour is retained for mill atta.

By adding the above two weight obtained from the two sieve sizes for each flour we get the impurity for that specific flour. The purity of the flours is determined by subtracting the impurity from 100. This will give the purity of flour in percentage. Minimum purity for maida I and maida II must be 95%, for chakki atta must range from 55% to 62% and for mill atta must range from 25% to 35%. The results are shown in Table 5.

Sharbati variety

The purity of maida I was found to be 98.55%, for maida II was 97.64%, for chakki atta was found to be 98.767%.

Lokwan variety

The purity of maida I was found to be 97.939%, for maida II was 97.337%, for chakki atta was 65.208% and mill atta was found to be 27.752%.

The impurity of flour is due to the presence of bran and germ. The percentage of of bran and germ in sharbati variety was less as compared to lokwan variety. Due to this reason the impurity percentage in lokwan variety maida I, maida II, chakki and mill atta was found to be more than sharbati variety.

Colour testing of flours

The colour of the flours obtained varies as per the varieties of wheat. The two varieties shows difference in color obtained from the

color testing of the flours. It is basically a sensory test which was compared by using a pre defined scale. Table 6 shows the results obtained from the flours of sharbati and lokwan variety.

From the table we can compare the colour of the two varieties of wheat that the maida from sharbati variety gives a brighter and lighter colour as compared to the lokwan variety maida. There was no difference in the colour in the chakki atta, mill atta and semolina of the two varieties of the wheat. The bran and germ in lokwan was in high percentage giving the flours obtained from it a dull colour as compared to sharbati variety flours. Since bran and germ are included in the atta and semolina there was no difference in their colour and variation was observed only in the maida obtained from the two varieties.

Moisture content of flours

The moisture of wheat is measured by AACC International Approved Methods of Analysis of Moisture Air-Oven Method. The results are shown in tabular form in Table 7.

From above table we found that the moisture content obtained for sharbati maida I is 13.724%, for maida II is 13.129%, for chakki atta is 11.077%, for mill atta is 14.38% for semolina I is 13.88% and for semolina II is 14.38%.

The moisture content obtained for lokwan maida I is 12.010%, for maida II is 12.448%, for chakki atta is 10.532%, for mill atta is 12.731%, for semolina I is 12.961%, and for semolina II is 13.6599%.

The moisture content of sharbati wheat was more than lokwan wheat the moisture content of their respected flours was more for sharbati variety as compared to that of lokwan variety.

Ash content

The moisture of wheat is measured by AACC International Approved Methods of Analysis of Ash-Basic method. The AACCI Method is based on the fact that when a sample is incinerated in an oven, the high temperature vaporizes the moisture and burns away all the organic materials (starch, proteins, sugars, and fat), leaving only the ash. The residue is composed of the non-combustible, inorganic minerals that are concentrated in the bran layer. The results are shown in tabular form in Table 8.

According to the Food Safety and Standards Authority of India (FSSAI) the allowable ash content for maida I, maida II and mill atta is maximum 1% while for chakkiatta is 5% at most.

From above table we can see that the ash content in sharbati variety obtained for maida I is 0.509%, for maida II is 0.815%, for chakkiatta is 1.43% and for mill atta is 0.565%. The ash content in lokwan variety obtained for maida I is 0.719%, for maida II is 0.922 %, for chakkiatta is 1.669 % and for mill atta is 0.846%.

Gluten content

Gluten is measured on wet basis and dry basis. Hot air oven is used for measurement of gluten. Separate tables show the result for the gluten percentage in wet basis (Table 8) and in dry basis (Table 9).

Minimum gluten content for good quality flour on wet basis must be minimum 6% and as for dry basis it must be minimum 7.5%.

Table.1 Average dimensions of the two variety of wheat

Variety	Length (mm)	Breadth (mm)	Thickness (mm)
Sharbati	6.055	3.433	2.733
Lokwan	7.1	3.411	2.766

Table.2 Result obtained from the hectolitre test.

Variety	Volume (ltr)	Mass (kg)	Hectolitre Mass (kg/hl)
Sharbati	0.5	0.410	82
Lokwan	0.5	0.390	78

Table.3 Moisture content of wheat in percentage (%)

Variety	Moisture Meter (%)	Air Oven Method (%)
Sharbati	15.19	15.28
Lokwan	14.11	14.82

Table.4 Retained flour on various sieve sizes in grams

Variety	Maida I		Maida li		Chakki Atta		Mill Atta	
	150µ	132µ	180µ	132µ	212µ	132µ	212µ	132µ
Sharbati	0.052	1.398	0.196	2.156	5.489	10.736	9.7	60.472
Lokwan	0.079	1.982	0.250	2.413	5.025	12.371	10.246	62.002

Table.5 Purity and impurity of various flours

Variety	Maida I		Maida Ii		Chakki Atta		Mill Atta	
	Impurity	Purity	Impurity	Purity	Impurity	Purity	Impurity	Purity
Sharbati	1.45	98.55	2.352	97.64	1.233	98.767	1.33	98.677
Lokwan	2.061	97.939	2.663	97.337	17.396	65.208	72.248	27.752

Table.6 Colour variations of different flours

Variety	Maida I	Maida Ii	Chakki Atta	Mill Atta	Semolina I	Semolina Ii
Sharbati	Bright White	Cream White	Golden Brown	Off White	Golden Brown	Golden Brown
Lokwan	Cream White	Off White	Golden Brown	Off White	Golden Brown	Golden Brown

Table.7 Moisture content of different flours in percentage(%)

Variety	Maida I	Maida Ii	Chakki Atta	Mill Atta	Semolina I	Semolina Ii
Sharbati	13.724%	13.129%	11.077%	13.66%	13.88%	14.38%
Lokwan	12.010%	12.448%	10.532%	12.731%	12.961%	13.6599%

Table.8 Ash content of different flours in percentage(%)

Variety	Maida I	Maida Ii	Chakki Atta	Mill Atta
Sharbati	0.509%	0.815%	1.43%	0.565%
Lokwan	0.791%	0.922%	1.669%	0.846%

Table.9 Gluten content of different flours in percentage(%) on wet basis

Variety	Maida I	Maida Ii	Chakki Atta	Mill Atta
Sharbati	7.85%	9.401%	8.416%	8.38%
Lokwan	7.141%	8.456%	8.016%	8.0132%

Table.10 Gluten content of different flours in percentage(%) on dry basis

Variety	Maida I	Maida Ii	Chakki Atta	Mill Atta
Sharbati	9.263%	10.87%	9.338%	9.691%
Lokwan	8.300%	8.849%	8.208%	8.452%

Table.11 Water absorption power of different flours in percentage(%)

Variety	Maida I	Maida II	Chakki Atta	Mill Atta
Sharbati	60%	60.4%	68%	66%
Lokwan	60%	60.4%	68%	66%

Table.12 Height of bread made from maida of the two varieties of wheat

Variety	Height Of Bread (cm)
Sharbati	12
Lokwan	10.2

From above table we found that the gluten content of sharbati variety on wet basis obtained for maida I is 7.85%, for maida II is 9.401%, for chakkiatta is 8.416% and for mill atta is 8.38%. The gluten content of lokwan variety on wet basis obtained for maida I is 7.141%, for maida II is 8.456%, for chakkiatta is 8.016% and for mill atta is 8.0132%.

From above table we found that the gluten content for sharbati variety on dry basis obtained for maida I is 9.263%, for maida II is 10.87%, for chakkiatta is 9.338% and for mill atta is 9.691%. The gluten content for lokwan variety on dry basis obtained for maida I is 8.300%, for maida II is 8.849%, for chakkiatta is 8.208% and for mill atta is 8.452%.

Water absorption power

The amount of water required to make the dough for gluten is multiplied by 4 to get the water absorption power of flour for 100 gms. It is expressed in terms of %. Table 11 shows the water absorption power of various flours of the two varieties of wheat.

For a good quality flour minimum water absorption power for maidaI, maidaII, mill atta and chakkiatta must be minimum 60%. From above table we found that the water absorption power obtained for maida I

is 60%, for maida II is 60.4%, for chakkiatta is 68% and for mill atta is 66% which is same for both the varieties of wheat .

Strength testing of flour

The strength of flour is determined by making bread the obtained flours from the varieties of wheat. The bread is made under same conditions and the procedure is followed for making the bread is also same. Table 12 shows the results obtained from the strength testing of flours.

From above table we found that the height of bread made from sharbati variety was 12 cm and from lokwan variety was found to be 10.2 cm. The rise in bread during the procedure occurs due to fermentation produces carbon dioxide bubbles, which, trapped by the gluten network. Gluten it binds water through hydration. From gluten test we already found that the gluten percentage is more in sharbati as compared to lokwan thus signifying the strength of bread. This test also done for finding the quality of flours. The more the rise in bread the more good quality flour it is said.

It can be concluded that in terms of moisture content, ash content , taste, color from the two varieties' of wheat and its flours sharbati variety wheat gives better results as compared to the lokwan variety. As for making chapati and as an healthy option lokwan variety wheat

flour is considered more better option as the gluten content is less which is considered unhealthy for consumption and it consists fibre at higher percentage as compared to sharbati. The appearance and taste of the bakery products made from sharbati variety maida gave much appealing results as compared to the lokwan variety. The colour of the sharbatimaida was brighter which is taken into account for enhancing acceptability in the high quality bakery products as compared to the lokwan giving a dull colour. As per the study it can be stated that sharbati variety is much more better option as compared to the lokwan variety in may aspects. Both varieties shows difference in results making them acceptable in market as per the desirable further use of them which gives satisfactory products as per the demand.

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