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RESEARCH ARTICLE

STUDIES ON ENLARGEMENT OF RICE LIKE READY TO COOK CONTRIVED GOODS FROM SOFT AND HARD WHEAT GRAINS

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ABSTRACT

In this study different process parameters were optimized for the preparation and cooking of RTC product from soft and hard wheat grains. During the experiment it was found that the medium size grits (2-1.5mm) of soft and hard wheat grains cooked separately with each 2.5 times of water (v/v) for 30 and 20 min, respectively resulted in complete gelatinization of starch and presented a food similar to cooked rice. The sensory evaluation of cooked soft and hard wheat samples recorded as high score values of 8.5 and 8.3, respectively. Though there were no notable differences in quality among wheat varieties, RTC product prepared from hard wheat variety is recommended for consumption because of its relatively high protein content which delays the digestion, helps the consumer to feel stomach full between meals and thereby reduces the quantity and in turn helps in normalizing the blood glucose level for diabetic persons.

INTRODUCTION

Cereals are the staple food resource of the world. Wheat is one of the three most important crops in the world, together with maize and rice and used to produce a wide variety of baked food products. Wheat varieties are often broadly classified as hard and soft, although other subclasses do exist. Hard wheat varieties generally have a harder texture than soft wheats and are genetically different from soft wheats. Whole-grain foods contain all the essential parts and naturally occurring nutrients of the entire grain. Whole grains are a rich source of magnesium, a mineral that acts as a co-factor for more than 300 enzymes, including enzymes involved in the body's use of glucose and insulin secretion. The FDA permits foods that contain at least 51% whole grains by weight (and are also low in fat, saturated fat, and cholesterol) to display a health claim stating consumption is linked to lower risk of heart disease and certain cancers. Now, research suggests regular consumption of whole grains also reduces risk of type 2 diabetes. (van Dam RM, Hu FB, *Diabetes Care*).

According to International Diabetes Federation (IDF), India will soon have the dubious distinction of being home to 700 Lakh diabetics by 2012. Most common advice to diabetic patients is to eat chapathi or any wheat products because this will be digested slowly by the human system than rice and may help you feel fuller between meals, which helps with weight management and may help normalize blood glucose levelsand lower blood cholesterol. In addition to this, it helps in portion control. In south India, even though many people want to switch over from rice to wheat products, because of the form in which wheat products are taken restricts them to take wheat products. Especially for south Indians, rice is the stable cereal other than ragi, jowar etc., and they like to take any food in the form similar to rice. This study relates to processing whole wheat grains for preparing chewable whole wheat grains for eating. As is well known, whole wheat grains or berries comprise an outer shell of bran enclosing endosperm and wheat germ, all three of which components have significant nutritive value. In this respect, the bran is high in fiber content, and all three components are rich in vitamins and minerals.

The bran shell in raw wheat is extremely hard, whereby it is impossible to chew and thus eat the whole grains in their raw state. A process is provided by which chewable wheat grains are prepared from raw whole wheat in a manner which optimizes the flavour and texture of the wheat grains and the retention of the nutrient value of the three components thereof. The cooked wheat grains can be consumed immediately as a food in combination with sambar, rasam, curd, cooked vegetables etc. Considering the outstanding importance of wheat to man, curiously, a research was undertaken with the following objectives namely (i) to study the properties of raw, soaked and parboiled grains of soft and hard wheat (ii) to prepare the Ready To Cook (RTC) product using soft and hard wheat grains (iii) to optimize the process parameters for preparing RTC product and cooking and (iv) to evaluate the cooked food prepared using optimized RTC product organoleptically.

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MATERIALS AND METHODS

Raw Materials

Hard and Soft wheat grains were procured form the local market and placed in sealed bags and stored in a refrigerator until the experiments. The moisture contents of the samples were determined by the air oven method (AOAC, 1985) in triplicate and the average value was expressed in percentage wet basis (wb). The initial moisture content of the hard and soft wheat grains was found to be 9–10% (wb), respectively.

Physical Properties of Wheat

Determination of physical characteristics of grain and agricultural commodities is important in the design of harvesting, handling, and processing equipment. To determine the average size of the grain at 9-10%(wb) moisture content, a sample of 50 randomly selected kernels of each variety and their three principal dimensions were measured using a Vernier caliper having a least count of 0.01 mm and the average was recorded. Hundred kernel weight (HKW) was measured by manually counting 100 grains and weighing them in an electronic balance having ±0.001 g accuracy. The bulk density of the grain based on volume occupied by the bulk sample was measured by placing a sample with predetermined moisture content into a known volume of a cylindrical container. The bulk density was determined by dividing this weight by the volume of the container. This method was repeated five times; the averaged bulk density was thus determined.

Parboiling of Wheat Grains

After the wheat is cleaned, it was washed in cold water and soaked overnight at room temperature. The moisture content of the grains was raised from 9-10% to 44–45% (wb) and the soaked sample was boiled in an uncovered copper kettle for one hour. Water was added in such an amount that of the grains were covered by it. The initial and final moisture content were determined by standard oven method (AOAC, 1985). Parboiling was stopped judging the uniformity in the gelatinization of the starch throughout the endosperm by a translucent appearance and absence of opaque spots. After parboiling water was drained and the samples were spread on trays and dried in shade until it reaches the moisture content of 9-10% (wb).

Milling of Wheat Grains

Burr mill and Pin mill were used to reduce the size of the wheat grains. Burr mill consisted of a feed hopper for feeding the raw material and two metallic discs of 18 cm diameter, each having serrated rough surfaces to break the grains. In that one disc was fixed as stationary one and the other one was rotated by belt pulley driven by a power drive. By adjusting the clearance between the two discs, it is possible to alter the size of the grits obtained. A clearance adjustment wheel was used to adjust the clearance and a lock lever provided was used to fix the clearance. The feed rate was controlled by a shutter provided at the bottom of the feed hopper. The milled wheat was collected, sieved through required sieves and adjusted the clearance to get correct proportions of different grits and powder. Pin mill consisted of two vertical plates with horizontal projections on their inner faces. One plate is stationary while the other rotates at high speeds. The wheat was fed through the hopper to the center of rotating plates and was thrown outward by centrifugal action. The wheat grains were crushed into small particles by means of rubbing and impact actions. Control of size of the product was affected by means of speed of the plate and spacing between the projections. Pin mill gave uniformly fine product with little dust compared with burr mill and used for milling of wheat grains.

Experimental design for Optimizing the Process for the preparation of Cooked Wheat Grains

To optimize the different size grits to be used, water to be added, duration of cooking etc., for the preparation of cooked wheat, in order to get good quality, organoleptically acceptable food, which will give mouth feel of eating a food during eating, the independent variables such as wheat variety (hard wheat and soft wheat), particle size (large grits (3-2 mm), medium grits (2-1.5 mm) and small grits (<1.5 mm)), Water mixing ratio (2, 2.25 and 2.5 times by volume of grain) and duration of cooking (10, 20 and 30 min) and the dependent variables such as presence of excess water, completion of cooking and organoleptic evaluation were studied.

Cooking of milled wheat grains

In this process wheat grains were cooked in a pressure cooker with added water. In order to avoid variations in the final product, during cooking a constant weight of grains was used in all the tests. The volume of water in the pressure cooker to produce steam, gas flow in the gas stove during cooking tests were kept constant to avoid the possible effect of these parameters on the quality of final product prepared. The cooked food without excess water and showed uniform spreading in the form of thin sheet without any white core mass at the centre when pressed between two glass plates was considered as food obtained after completion of cooking. The quantity of water added and duration during which the mix was cooked were considered as optimum quantity of water to be added and optimum duration of cooking. The tests were repeated for two times and the average values were recorded.

Organoleptic evaluation

Cooked wheat samples were tested for their organoleptic attributes. All these samples were kept under ambient condition during the test period. A panel of 15 persons in the age group of 20 to 55 with different education level and sex were selected. The panel was briefed about the experiments and the samples placed for evaluation. The score record sheets were prepared based on nine point hedonic scale and the score values were recorded.

RESULTS AND DISCUSSION

Physical Properties of Hard and Soft Wheat Grains

The size of the raw, soaked and parboiled soft and hard wheat grains in terms of length, width and thickness were measured using a Vernier caliper having a least count of 0.01 mm and presented in Table 1. From the table it is seen that the hard wheat was longer than soft wheat by nature, whereas the width and thickness was more in soft wheat than hard wheat. On soaking, the length, width and thickness of soft and hard wheat grains were increased by 4.97, 7.54 and 5.80% and 5.86, 39.32 and 25.62%, respectively. In the case of parboiled soft and hard wheat grains, the percentage of increase in length, width and thickness were 13.74, 29.86 and 21.50% and 10.49, 48.29 and 30.99%, respectively. Hundred grains weight also increased by 12.88 and 52.18% on soaking and parboiling, respectively in case of soft wheat and 17.81 and 47.81% in case of hard wheat. From the results it is very clear that the hard wheat grains absorbed more water than soft wheat grains during soaking and parboiling which in turn increased the hundred grains weight. On comparing soaking and parboiling, diffusion of water in grains was more during parboiling irrespective of the wheat variety. This may be due to the large temperature gradient exist between the grains and the heating medium during parboiling.The parboiled soft and hard wheat grains were shade dried at 30±2oC to study the drying process and volumetric changes. The effect of moisture content on bulk density and rate of change of moisture content with respect to time are depicted in Figs. 1&2. It is seen from the **Fig.1.** that the bulk density increases upon decrease in moisture content for both the soft and hard wheat.

Table 1. Physical properties of wheat grains

Sample	Length (cm)	Width (cm)	Thickness (cm)	100 grains weight (g)
Soft wheat				
Raw wheat	0.784	0.345	0.293	4.58
Soaked wheat	0.818	0.371	0.310	5.17
Parboiled wheat	0.878	0.448	0.356	6.97
Hard wheat				
Raw wheat	0.734	0.234	0.242	3.20
Soaked wheat	0.777	0.326	0.304	3.77
Parboiled wheat	0.811	0.347	0.317	4.73

Effect of moisture content on bulk density and rate of change of moisture content of soft and hard wheat grains

At different moisture levels, bulk density of soft and hard wheat grains varied from 680.2 kg/m3 to 714.5 kg/m3 and 668.4 kg/m3 to 712.3 kg/m3 ,respectively and indicated a decrease in bulk density with increasing in moisture content.Similar results were reported by Tabatabaeefar, (2003) for varieties of irrigated wheat and varieties of dry land wheat. It is also observed from the figure that the change in bulk density of both soft and hard wheat grains was found to have linear relationship with moisture content and followed a regression equation of the form

Soft wheat: $y = -1.202x + 724.14$, $R2 = 0.9815$ ---(1)
Hard wheat: $y = -1.5696x + 724.43$, $R2 = 0.9765$---(2)

From Fig.2. it is clear that the rate of change of moisture of soft and hard wheat grains was higher at the beginning and gradually decreased with time. During first five hours the drying rate of soft and hard wheat was 1.65 and 1.44 kg/hr, respectively and towards the end of 70 hours of drying in shade it was decreased to 0.39 and 0.49 kg/hr. It is also seen from the figure that the change in moisture content of both soft and hard wheat grains was found to have a logarithmic relationship with time and can be represented by a regression equation of the form

Soft wheat: $y = -0.245\ln(x) + 1.0587$, $R2 = 0.9972$--(3)
Hard wheat: $y = -0.18\ln(x) + 0.8975$, $R2 = 0.9824$--(4)

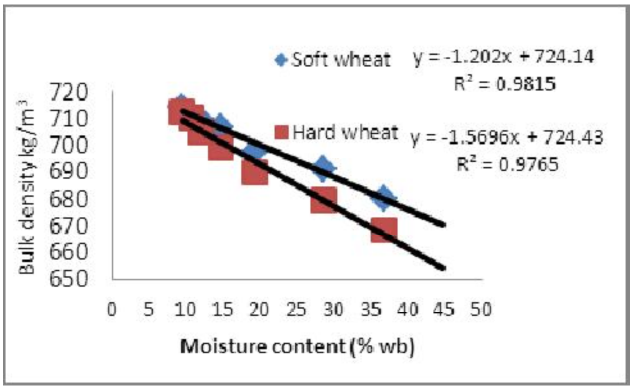

Fig. 1.Effect of moisture content on bulk density of soft

Optimization of Process Parameters for the Preparation and Cooking of Rice like RTC Product from Soft and Hard Wheat Grains

The required quantity of small (<1.5 mm), medium (2-1.5mm) and large grits (3-2 mm) of soft and hard wheat grains were taken for cooking studies to optimize the wheat variety for preparing good quality RTC product in terms of grit size, water to be added and duration of cooking. The different grits of hard and soft wheat grains were mixed with different quantity of water (volume/volume basis) and cooked for different durations. After cooking, the parameters like completion of cooking, insufficient water for cooking, presence of excess water on cooked food, presence of white core were observed. Thickness of the wheat grain seems to have more effect on the time of cooking perhaps due to quick diffusion of moisture in grains of smaller thickness. It is observed that the soft wheat grains on cooking resulted in a stout stumpy appearance as compared to cooked hard wheat grains. Cooking of milled wheat grains was faster as compared to whole wheat grains and yielded a soft food. This may be due to the direct exposure of starchy endosperm to water during cooking process which helps to absorb water more quickly at the surface and diffusion into the grain.

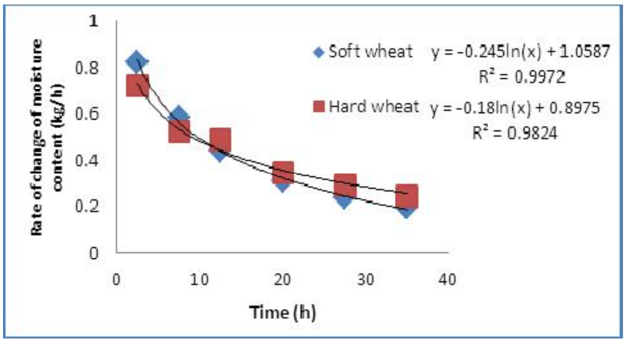

Fig. 2. Rate of change of moisture content with respect to time

The results of the effects of wheat variety, particle size, mixing ratio of wheat grains to water and duration of cooking on complete gelatinization of starch showed that both increase in duration of cooking from 10-30 min and increase in addition of water from 2 to 2.5 times in steps of 0.25 times resulted in complete gelatinization of starch of both the varieties of wheat grains of different size grits. That is, there is no white core at the centre of the thin sheet pressed between plates and hence reported as complete cooking. On visual observation of the cooked samples of hard and soft wheat kernels pressed between the plates, presence of white core was observed, in some samples where less water (2 times) was added and cooked for lesser time (10 min). This is due to insufficient water taken for the cooking test and lesser cooking time adopted.

The large, medium and small grits of hard wheat samples showed excess of water when cooked with 2.5 times of water for lesser duration (10 min). This is due to incomplete cooking of samples in lesser time. For the same quantity of water, when the cooking time was increased to 20 and 30 min showed complete gelatinization of starch but the cooked sample become a sticky mass for the cooking time of 30 min. The presence of white core was observed for the samples cooked with 2.25 times of water. This may be due to insufficient water added for cooking. The sample cooked with 2.5 times of water for 20 min resulted in complete gelatinization of starch and cooked grains were not sticking to each other and presented a food similar to cooked rice. Soft wheat samples cooked with 2.5 times of water for 10 min showed excess of water irrespective of particle size. This is due to incomplete cooking of samples in lesser time. The samples cooked with 2 and 2.25 times of water for 20-30 min resulted in incomplete gelatinization of starch. This may be due to insufficient water for cooking. The sample cooked with 2.5 times of water for 30 min resulted in complete gelatinization of starch and cooked grains were not sticking to each other and presented a food similar to cooked rice.

Organoleptic evaluation of cooked wheat samples

The cooked samples of hard and soft wheat grains based on the optimized parameters were evaluated organoleptically using nine point Hedonic scale.

Table 2. Organoleptic evaluation of cooked wheat samples

Parameters	Cooked Hard wheat				Cooked Soft wheat			
	a	b	c	d	e	f	g	h
Color and appearance	8.2	8.1	8.4	8.0	8.6	8.5	8.6	8.2
Flavor	8.5	8.5	8.6	8.6	8.7	8.7	8.8	8.6
Taste	8.7	8.8	8.8	8.2	8.8	8.8	8.9	8.1
Texture	7.9	8.2	8.7	7.8	7.7	8.0	8.6	7.8
Overall acceptability	7.5	7.5	8.3	7.6	7.4	7.6	8.5	7.8

a=Whole grains; b=Large grits; c=Medium grits d=Small grits; e=Whole grains; f=Large grits; g=Medium grits; h=Small grits

Notable differences were observed in various quality attributes only among the different particle sizes of wheat variety but not in the varieties of the cooked wheat samples. The cooked samples obtained using medium grits of hard and soft wheat varieties recorded higher texture values (8.7 and 8.6 respectively and qualitatively this value was lying between like extremely and like very much) and overall acceptability values (8.3 and 8.5 respectively and qualitatively this value was lying between like extremely and like very much). The cooked sample prepared from small grits of hard and soft wheat varieties recorded the lowest scores for different quality attributes. From the score values, it is clear that the food prepared using RTC product from hard and soft wheat grains are of acceptable quality.

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