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Impact of wheat-oat blending on extensibility of dough

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Abstract
The work was carried out in the Department of Food Technology, Islamic University of Science and Technology Awantipora during the year 2010-2011. Oat flour was incorporated into wheat flour at 0, 10, 20 and 30% substitution levels for preparation of bread. Monosodium Glutamate was added @ 0, 0.3 and 0.5%. Rheological evaluation of dough was carried out before and after fermentation. Results revealed that the mean value for extensibility showed no significant increase (26.02-29.07) before fermentation and a significant decrease (22.51 to 21.03) after fermentation with addition of Monosodium Glutamate. Increase in level of oat flour incorporation resulted in decrease in extensibility before and after fermentation.

Keywords: Bread, Fermentation, Monosodium Glutamate, Oat flour, Wheat flour.

1. Introduction
Bread is an ideal functional food product, since it is an important part of our daily diet. Different types and forms of bread are consumed in world in large quantity depending on cultural habits (Cayot, 2007) [1]. Then early ubiquitous consumption of bread places it in a position of global importance in human nutrition. Bread is a staple food prepared by cooking dough of flour and water and often additional ingredients. Bread is one of the oldest prepared foods and dates from 30,000 years ago. It is estimated that the first bread was made around 10,000 years BC or over 12,000 years in the past. Bread is usually made from a wheat-flour dough that is cultured with yeast, allowed to rise, and finally baked in an oven.

Wheat (*Triticum aestivum*) is the most important crop for bread making due to its supreme baking performance compared to other cereals (Dewettnick *et al*., 2008) [2]. The chemical composition of wheat and other grains used in bread making is determined by genetic and ecological factors and by physical and chemical effects acting on the grain during its processing. The primary quantitative component of wheat is starch. Apart from starch, it contains carbohydrates like cellulose, hemi-cellulose (pentosans) and sugars. Although the content of pentosans is only 2-3%, are important owing to their water absorbing capacity. Proteins are among the basic nutritional components of grain. The main proteins present are albumins, globulins, prolamins and glutelins. The third important component of wheat is fat. Carotenoids are found mostly in the embryo and in the aleurone layer and have considerable nutritional value.

Oat (*Avena sativa*) is one of the most adventurous cereal grains for human diet since it contains naturally high amounts of valuable nutrients such as soluble fibres, proteins, unsaturated fatty acids, vitamins, minerals and phytochemicals (Flander *et al*., 2008) [3]. Moreover, same studies show that oats can be tolerated by most people suffering from celiac disease (Kupper, 2005) [4]. Oat has excellent moisture retention properties that keep breads fresher for longer periods of time (Flander *et al*., 2007) [5]. Owing to its particular chemical composition and nutritive and physiological values, oat grain is the object of extensive studies. Oat grain is characterised by a good taste, dietetic properties and an activity stimulating metabolic changes in the body. All this makes its nutritive value high for both people and animals (Brand and Merwe, 1996; Lia *et al*., 1997; Peltonen-Sainio *et al*., 2004; Peterson, 2004) [6, 7, 8, 9].

2. Material and methods
The work was carried out in the Department of Food Technology, Islamic University of Science and Technology Awantipora during the year 2010-2011. Oat was purchased from Srinagar and then milled in a mixer to obtain a whole flour. The flour was stored in plastic air tight containers at refrigerated temperatures until used. Refined wheat flour, shortening, compressed yeast was purchased from local market of Srinagar.

The formulations of the oat enriched breads were according to the Table 1. Composite flours were prepared as mentioned in Table 2.

Table 1: Wheat-oat composite bread formulations

Wheat flour/composite flour	**150 g**
Yeast	3.0 g
Sugar	6.0g
Salt	1.5g
shortening	3.0g

MSG was used at 0, 0.3, 0.5% level. The ingredients were weighed accurately and the yeast was activated in hot water. All the ingredients were mixed in a vessel and yeast was added while considering the amount of water. The dough was then placed in an incubator at 37 ^{0}C for fermentation. Dough was taken out after 1 hour and then knocked back to remove the excess gases. The dough was again placed in incubator for fermentation and removed after 30 min, knocked back, rolled and molded into pans and then allowed to ferment for another 35 min.

Table 2: Wheat-oat composite flours used for bread formulations

Treatment		**Concentration of MSG**	**Wheat flour (%)**	**oat flour (%)**
T1	T_1M_1	0.0%	100%	0%
	T_1M_2	0.3%	100%	0%
	T_1M_3	0.5%	100%	0%
T_2	T_2M_1	0.0%	90%	10%
	T_2M_2	0.3%	90%	10%
	T_2M_3	0.5%	90%	10%
T_3	T_3M_1	0.0%	80%	20%
	T_3M_2	0.3%	80%	20%
	T_3M_3	0.5%	80%	20%
T_4	T_4M_1	0.0%	70%	30%
	T_4M_2	0.3%	70%	30%
	T_4M_3	0.5%	70%	30%

2.1 Rheological Analysis

A Texture Analyzer (TA. HD. Plus, stable Micro Systems, Godalming, Surrey, U.K.) was used to measure the extensibility. For extensibility, the dough strip was placed onto the grooved region of the sample plate and the plate was inserted into the rig while holding down the spring-loaded clamp lever. The handle was released slowly. The analysis was done to a distance of 75 mm, at a pre-test speed of 2.0 mm/s, test speed of 3.3 mm/s, post-test speed of 10.0 mm/s using a 5 Kg load cell.

2.1.1 Extensibility

Extensibility indicates the amount of elasticity in the dough and its ability to stretch without breaking.

2.1.1.1 Sample preparation

Small amount of oil was applied to both sides of teflon dough form, to avoid sample adhesion. A sample of dough was placed on the grooved base of the form. The upper block of the form was positioned on top of sample and pushed down firmly until two blocks come together. Excess dough was removed cleanly from sides, using a spatula and dough was clamped in the form press for 40 minutes. Excess dough that was forced out from the sides of the form was scraped. The dough press was loosened and carefully sided from block backwards over the grooved base to uncover the dough strips. The strips of dough were removed from grooved base, by carefully sliding a spatula dipped in oil under the sample. The first and last few strips were not used.

2.1.1.2 Test set up

The kieffer rig was positioned on the machine base. The hook probe was lowered to just above the upper surface of spring loaded clamp. The dough strip was placed onto the grooved region of the sample plate and the plate was inserted into the rig while holding down the spring-loaded clamp lever. The handle was released slowly. The test was commenced.

2.1.1.3 Observations

Once a trigger force was attained the hook then proceeded to centrally extend the dough sample until its elastic limit was exceeded and the dough separated. At this point the distance was noted and used as an indicator of dough extensibility.

3. Result and discussion

3.1 Extensibility before fermentation

With increasing concentration of MSG, the mean value of extensibility of dough increased from 26.02-29.07. The addition of oat flour resulted in reduction of mean value of extensibility from 33.17-20.28. Further the highest mean extensibility was observed in T_1 and lowest mean extensibility was observed in T_4 (Table. 3). MSG caused weakening of gluten structure before fermentation. The weakening action is frequently referred to in the art as gluten reducing action. This action of the monosodium glutamate is very desirable as it increases the pliability of the dough during the mixing and machining operations. These results are in accordance with the findings of Sternberg *et al*. (1976), who observed increase in extensibility of dough before fermentation due to the reducing action of MSG. The decrease in extensibility with addition of oat flour is due to glutenin dilution. Dough extensibility is primarily due to elasticity of glutenin proteins present in wheat which may dilute with the addition of non-wheat flour resulting in decreased extensibility. According to extensibility data obtained in this study, decrease in the gluten content of the dough and the increase of oat proportion (ending up with weaker formation of gluten matrix) could not maintain the dough extensibility. In this study, as the oat level in the flour increased, the time needed for the preparation of a good dough was also increased, due to a weaker formation of gluten matrix. Since pentosans and β-glucans benefit from high water binding capacities, their presence in the oat flour caused slightly higher water

Table 3: Extensibility (mm) of wheat-oat dough at different concentrations before fermentation.

Treatment	Extensibility			Treatment mean
	M_1	**M_2**	**M_3**	
T_1	31.10	33.01	35.42	33.17
T_2	29.10	30.12	33.20	30.80
T_3	24.01	25.42	26.93	25.44
T_4	19.98	20.17	20.98	20.28
MSG mean	26.02	27.17	29.07	

CD P≤0.05
Treatment (T): 0.18
MSG (M): 0.16
TXM: 0.32
T_1 = Control bread (100% W.F) M_1 = 0% MSG
T_2 = 10% W.F: 90% O.F. M_2 = 0.3% MSG
T_3 = 20% W.F: 80% O.F. M_3 = 0.5%MSG
T_4 = 30% W.F: 70% W.F = Wheat flour. O.F = Oat flour

Absorption capacities, for doughs made of oat as part of the formula, in comparison with control. Similar results have been reported by Sudha *et al.* (2007) [11] when studying the effect of adding fiber of different sources (wheat, rice, oat and barley) to wheat flour on the rheological properties of the dough. The above data were all in good agreement with those obtained by D'Appolonia and Youngs (1978) [12] and as well by Krishnan *et al.* (1987) [13].

3.2 Extensibility after fermentation

The mean values for extensibility statistically showed a significant decreasing trend from 22.51 to 21.03 with addition of MSG. Further the highest mean extensibility was observed in T_1 treatment (27.86) and lowest mean extensibility was observed in T_4 treatment (16.69) (Table 4). The oxidation action of the monosodium glutamate which continues after the gluten reducing action is completed, strengthens the walls of the gas cells during the proofing of the dough products to provide a uniform fine-grained structure in the baked product with high volume. These results are in alignment with the findings Sternberg *et al*. (1976) [10] who observed that MSG caused strengthening of gluten network after fermentation due to the oxidative action. The decrease in extensibility with addition of oat flour is due to glutenin dilution. The results are in alignment with the findings of Khatkar, (2004) [14] who reported that dough extensibility is primarily due to elasticity of glutenin proteins present in wheat which may dilute with the addition of non-wheat flour resulting in decreased extensibility.

Table 4: Extensibility (mm) of wheat-oat dough at different concentrations after fermentation.

Treatment	Extensibility			Treatment mean
	M_1	**M_2**	**M_3**	
T_1	29.12	28.34	26.10	27.86
T_2	24.79	24.04	22.54	23.77
T_3	20.43	18.24	17.32	18.65
T_4	15.72	16.20	18.16	16.69
MSG mean	22.51	21.69	21.03	

CD P≤0.05
Treatment (T): 0.019
MSG (M): 0.016
TXM: 0.032

4. Conclusion

The studies revealed that before fermentation the extensibility of the dough showed increase with addition MSG and decrease with addition of oat flour. After fermentation, the extensibility of the dough showed a significant decreasing trend with addition of oat flour and MSG. It was concluded from the present studies that breads made from 10% oat flour blend were better than other blended breads as far as extensibility was concerned.

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