J Food Sci Technol (January–February 2010) 47(1):128–131

SHORT COMMUNICATION

Baking loss of bread with special emphasis on increasing water holding capacity

Kotoki D. · Deka S. C.

Revised: 27 May 2009 / Accepted: 2 June 2009

Abstract Potato flour (PF), hydroxypropyl methylcellulose (HPMC) and honey were used as baking agents and their effects on baking loss and sensory quality were studied. PF at 1, 2 and 4% levels decreased baking loss followed by HPMC and honey. Water absorption was substantially high with the HPMC (70.8–80.8%) and PF (61.7–71.7%) compared to honey and normal standard bread. PF incorporation increased shelf-life (6–7 days) as compared to HPMC and honey. HPMC incorporated bread had higher moisture content (36.8–38.0%) followed by PF (34.5–35.8%) and honey (34.7%). The ash content was in the order of PF (1%) > honey (4%) > PF (2%) > normal bread > HPMC (0.5 g) > PF (4%) > HPMC (1 g) > HPMC (1.5 g). PF incorporated bread had sensorily highest acceptance followed by HPMC and honey.

Keywords Bread · Baking loss · Baking agents · Water holding capacity

Introduction

The quality of bread made from dough is influenced by dough formulation (Rouille et al. 2000). During baking, dough is transformed into bread through moisture loss, changes in structure and texture, increased volume and high energy consumption. Losses of moisture and starch retrogradation are accepted as the basic mechanisms in the firming of crumb. If too much moisture is lost, the product will be underweight and a dry crust may be produced, which can lead to difficulties when packaging the product. In addition, the water loss during the baking process has a disadvantageous effect on the freshness of baked goods which thereby age earlier and become stale. Inclusion of baking agents/dough improvers in bread formulations may overcome these problems (Lucas et al. 2005).

Hydroxypropyl methylcellulose (HPMC) is extensively used in baking industry. Hydrocolloids are of increasing importance as bread improvers as they can induce structural changes in the main components of wheat flour systems along the breadmaking steps and bread storage (Selomulyo and Zhou 2007). Breads with hydrocolloids (HPMC or locust bean gum), commercial soluble fibers or whole oat flour/wheat flour were found to increase water holding capacity (Rosell et al. 2001, 2007, Guarda et al. 2004, Rosell and Foegeding 2007, Mandala et al. 2009).

Potato flour (PF) is a very important class of dough improver in baking industry. Yanez et al. (1981) reported that PF can be used for wheat flour and it increased the overall characteristics of bread and has greater impact on water holding capacity. Yadav et al. (2007) investigated the textural properties of the acetylated enzyme properties of potato and sweet potato flours and found them suitable in products such as baked goods.

One of the most important nonconventional dough improvers is honey. Selomulyo and Zhou (2007) reviewed that honey is a good dough improver and improves the overall baking quality of dough/frozen dough. It also decreases staling and has a desirable effect on the colour development of crust and crumb of bread. Sensory evaluation by a consumer panel revealed that consumers preferred the colour of bread made from dough/frozen dough containing 6-8% honey (Addo 1997).

Currently researches have been focused on the development and application of different additives for improving the baking quality and extending the shelf life of baked products produced from dough/ frozen dough by retarding the staling process in stored bread (Selomulyo and Zhou 2007). Different food additives/baking agents have been tested for use as anti-staling agents and improvers in wheat bread. In the light of improving baking quality with respect

Kotoki D. · Deka S. C.
Department of Food Processing Technology,
School of Engineering, Tezpur University,
Tezpur - 784 028, India

Deka S. C. (✉)
E-mail: sankar@tezu.ernet.in

to baking loss, water holding capacity, shelf life and sensory properties the present investigation was undertaken to examine the effects of three baking agents/dough improvers viz., HPMC, PF and honey.

The ingredients for the preparation of standard (without incorporation of baking agent) as well as the incorporated breads included refined wheat flour (*maida*) (600 g), fat (4%), salt (1.75%), sugar (1.5%), soy flour (0.8%), guar gum (0.5%), yeast (4%) and water (61%). The other chemicals that were needed for the preparation of bread (standard) as well as the incorporated ones comprised of calcium propionate (0.4%), ammonium chloride (0.05%), sodium steroyl lactate (SSL) (0.3%) and potassium bromate (40 ppm). PF, honey and HPMC were procured locally. The method of bread preparation was followed as per AACC (1983). Potato incorporated bread was made using different levels of 1(P_1), 2 (P_2) and 4% (P_3) PF on the weight basis of amount of *maida* used. HPMC was incorporated at 0.5 g (H_1), 1 g (H_2) and 1.5 g (H_3) per 600 g *maida*. They were dissolved in water over heating and then cooled to form the gel. The preparation of honey incorporated bread was same as that of standard bread where instead of water, honey mixed water was used for dough making. This was done by adding 14.8 ml (4%) of honey in 370 ml of water. Determination of baking loss and water absorption capacity was as per Kandhari (1983).

Sensory evaluation of bread was conducted using a 7-point Hedonic scale rating as per Vulicevic et al. (2004). The texture "grain of crumb" was judged through the sense of touch and by observing crumb structure. The flavour/aroma "aroma of crumb" was judged by the sense of smell and taste. The mouthfeel "texture of crumb" was judged by the tactile character and eating quality (compressibility, resilience, elasticity, mouthfeel and moistness) of the bread. The coded samples per bread type were presented individually to 10 panelists. Water was used for mouth rinsing before and after each sample testing. The shelf life of the bread was determined as per the method described by Wassermanns (1969). The prepared breads were packed and stored at room temperature (24–25°C) and relative humidity of 75–78%.

The results are presented in Table 1. The PF bread produced less loss of moisture (4.7–7.9%) during baking as compared to the standard bread (11.8%). Baking loss decreased with the increased percentage of PF. Hence PF can aptly be used to decrease the baking loss. HPMC bread had low baking loss (6.6–8.4%). Honey caused baking loss of 8.9%. Comparison of, HPMC and honey evinced that PF was more effective in reducing the baking loss. This can be attributed to the fact that flours when mixed with PF increase the high starch swelling characteristics along with moderately high gluten strength (Bhattacharya et al. 2003).

The physical and mechanical properties of dough were affected by the incorporation of PF, HPMC and honey. Addition of PF did not affect the handling properties of the dough. Water absorption was substantially high with

Table 1 Quality of bread containing potato flour, hydroxypropyl methylcellulose (HPMC) and honey

Parameters	Formulations							
	Normal bread*	P_1	P_2	P_3	H_1	H_2	H_3	Honey, 4%
Water absorption, %	61.7	61.7	66.3	71.7	70.8	73.3	80.8	61.7
Baking loss, %	11.8	7.9	5.8	4.7	8.4	7.0	6.6	8.9
Moisture, %	32.8	34.5	34.7	35.8	36.8	37.8	38.0	34.7
Ash, %	1.30	1.50	1.38	1.25	1.26	1.09	0.95	1.40
Shelf life, days	4	7	6	6	5	5	5	5
Sensory quality	**(7-point scale, n=10 panelists)**							
Colour	6.5	7.0	7.0	7.0	5.0	7.0	6.6	5.5
Flavour	5.5	5.9	6.0	6.9	6.0	6.3	6.3	6.5
Appearance	5.5	6.8	6.9	7.0	6.3	6.3	6.3	6.4
Softness	4.7	7.0	7.0	7.0	6.0	6.6	6.6	6.5
Taste	4.7	6.8	6.9	7.0	7.0	7.0	7.0	6.3
Crumb colour	5.5	5.0	6.6	7.0	5.2	7.0	7.0	5.5
Crumb texture	5.6	6.4	7.0	7.0	5.0	6.1	6.0	5.5
Crust colour	6.1	5.2	7.0	7.0	5.3	7.0	6.0	5.4
Crust texture	6.1	4.5	5.7	6.9	5.0	5.5	6.0	5.4
Overall acceptability	5.4	6.9	6.9	7.0	6.1	6.6	7.0	5.5

(n=3);* Without potato flour, HPMC, honey

Potato content in bread dough (as % of *maida*): 1 (P_1), 2 (P_2) and 4 (P_3)

HPMC content in bread dough (g/600 g *maida*): 0.5 (H_1), 1.0 (H_2) and 1.5 (H_3) Honey

the addition of PF and HPMC, latter being more effective. The dough prepared by the addition of HPMC was easier to handle. It had some pasting properties which reduced the stickiness of dough to a great extent which is unlike with sweet potato (Mais and Brennan 2008). This property of HPMC can be used to reduce the dusting flour during the moulding of bread. Sultan (1990) reported that the water absorption is due to increase in quality of flour mix which also ensures the retention of moisture during dough processing for baked products. The addition of hydrocolloids (HPMC) to the dough improved bread quality by increasing water holding capacity, specific loaf volume and viscoelastic properties of the bread (Azizi and Rao 2004, Asghar et al. 2005, Tavakolipour and Kalbasi-Ashtari 2007). Honey did not affect the water holding capacity.

The moisture content of bread increased slightly with increase in the proportion of PF in bread. The results revealed that PF had a beneficial effect on the reduction of baking loss in bread. This characteristic of the potato is exhibited mainly by the starch in the potato. It has been reported that potato starch has desirable characteristics which differ significantly from the starch of other plant sources (Madsen and Christensen 1996). The high molecular weight amylase and phosphate groups esterified to amylopectin contribute to high transparency, swelling power and water binding capacity and freeze thaw stability of the potato starches (Yanez et al. 1981). HPMC also resulted in bread with higher moisture content compared to normal bread.

The HPMC bread had shelf life of 5 days as compared to 4 days for normal bread. In addition to shelf-life HPMC also acts like a source of dietary fiber (Cho et al. 1999). The use of HPMC as a potential additive for breadmaking was also recently reported by Rosell and Foegeding (2007). It gave a softer bread crumb and also had a retarding effect on the bread staling. Bread containing PF had storage stability of 6–7 days. The ash content was in the order of PF (1%) > honey (4%) > PF (2%) > normal bread > HPMC (0.5 g) > potato flour (4%) > HPMC (1 g) > HPMC (1.5 g). Several authors have also reported high shelf life with potato powder (Bhattacharya et al. 2003); however, use of HPMC can also increase the shelf life (Barcenas et al. 2004, Mandala et al. 2007). Honey is preferred in baked goods to keep them fresher (Viera and Ronsivalli 1999).

Sensory results revealed that the potato incorporated bread had the highest acceptance generally followed by HPMC and honey incorporated bread. Similar results with potato bread were also reported by Gattas et al. (1983) and Greene et al. (2004).

Conclusion

PF substantially decreased the baking loss and retained moisture for longer periods than normal bread. It increased the retention of bread softness and gave comparatively more shelf life as compared to other baking agents like HPMC and honey.

Acknowledgement We thank Modern Foods (I) Ltd, Hindustan Unilever Ltd, Chennai, India for helping to carry out the work.

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