INFLUENCE OF AMYLASES ON THE RHEOLOGICAL PROPERTIES OF WHEAT FLOUR WITH PARTIALLY DAMAGED STARCH

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Introduction

Amylases hydrolyze starch molecules to give diverse products including dextrins and smaller polymers composed of glucose units, and they are used to prevent staling and improve the texture and flavor of baked goods. During wheat milling a portion of the starch granules suffers mechanical damage and the content of damaged starch obtained is related with wheat hardness and milling technique (Hoseney, 1994). Some damage starch should be considered beneficial for yeast but excessive amount of it can reduce backing performance (Bettge et al, 1995). Damaged starch affect the physicochemical properties of wheat flour, causes higher water absorption capacity, which affects negatively dough physicochemical properties and rheological behaviour (Drapron y Godon, 1987). The aim of this work was to study the impact of amylases on rheological behaviour of flours with different levels of damaged starch.

Materials and Methods

Enzymes used were α-amylase (AMY) (Fungamyl 2500SG), maltogenic amylase (MAMY) (Novamyl 10000BG) and amyloglucosidase (AMG) (AMG 800BG), and mixtures of them, AMY+MAMY, AMY+AMG and AMY+MAMY+AMG. Unmodified wheat starch was milled in a disc mill in order to cause a greater rupture of starch granules. Two flours were prepared mixing partially damaged wheat starch and vital gluten (85:15 starch:gluten ratio). Flour 1 and flour 2 had 4.74% and 14.33% damaged starch content, respectively. Dough-mixing properties of flours were examined with a Brabender farinograph. Pasting properties of samples were determined using a Micro-Viscoamylograph (Brabender), the slurries were heated from 30 to 95°C, held for 5 min at 95°C, and cooled to 50°C, held for 5 min at 95°C. Heating and cooling rates were 3°C/min. Dough stickiness was determined using the SMS/Chen-Hoseney Dough Stickiness (TA.XT2i Texture Analyzer).

Results and Discussion

Farinograph parameters changed significantly with the level of damaged starch and the addition of amylases. Water absorption and development time incremented as damaged starch content increased. α-amylase and their mixtures decreased water absorption and development time in flour 2. Farinograph stability decreased as damaged starch content increased. Enzyme addition to both flour 1 and 2 decreased dough stability, except maltogenic amylase which increased stability when it was added to flour 1 (Table 1). Pasting profile, as measured by Viscoamylograph, was modified by damaged starch content and enzyme addition. Peak viscosity, viscosity at the end of cooling period and setback decreased as damaged starch content increased. In general, maltogenic amylase decreased dramatically peak viscosity. Pasting temperature did not change with the increment of damaged starch content and the addition of amylases (Table 2). Stickiness was determined from dough mixed using moisture based on farinograph absorption. Flour 2 showed higher stickiness than flour 1 due to their greater damaged starch content. Only addition of α-amylase to flour 1 and amyloglucosidase to flour 2 increased dough stickiness (Table 3).

Table 1: Effect of damaged starch and the addition of amylases on Farinograph parameters.

Sample	Water absorption (%)		Development time (min)		Stability (min)	
	Flour 1	Flour 2	Flour 1	Flour 2	Flour 1	Flour 2
Control	60.4	74.8	3.3	6.3	24,0	19.8
AMY	58.8	72.4	3.5	1.8	18.8	3.0
MAMY	60.4	75.0	3.3	5.8	50.0	14.3
AMG	60.4	75.0	3.3	6.5	24.0	9.0
AMY+MAMY	60.0	72.4	3.3	4.5	11.4	5.6
AMY+AMG	59.6	72.4	3.5	1.5	12.0	1.8
AMY+MAMY+AMG	59.6	72.4	3.3	3.8	6.3	5.3

DS Damaged starch, AMY α-amylase, MAMY maltogenic amylase, AMG amyloglucosidase.

Table 2: Effect of damaged starch and the addition of amylases on pasting properties.

Sample	PT (C°)		PV (UB)		Breackdown (PV - HPV)		Setback (CPV - HPV)		CPV (UB)	
	Flour 1	Flour 2	Flour 1	Flour 2	Flour 1	Flour 2	Flour 1	Flour 2	Flour 1	Flour 2
Control	87.8	88.4	98	68	5	4	98	66	191	130
AMY	87.7	87.8	99	66	6	4	97	62	190	124
MAMY	87.1	86.5	51	31	4	2	64	36	111	65
AMG	87.7	87.7	98	66	6	4	98	63	190	125
AMY+MAMY	86.5	87.1	44	33	2	2	59	35	101	66
AMY+AMG	87.7	87.7	94	64	5	5	96	61	185	120
AMY+MAMY+AMG	87.1	87.0	43	35	2	3	58	37	99	69

DS Damaged starch, AMY α-amylase, MAMY maltogenic amylase, AMG amyloglucosidase. PT Pasting temperature, PV Peak viscosity, CPV viscosity at the end of cooling period.

Table 3: Effect of damaged starch and the addition of amylases on Stickiness

Sample	Dough Stickiness	
	Flour 1	Flour 2
Control	34.6	56.5
AMY	43.4	54.5
MAMY	38.9	57.4
AMG	35.2	67.7
AMY+MAMY	33.7	58.6
AMY+AMG	31.9	60.7
AMY+MAMY+AMG	35.5	62.6

DS Damaged starch, AMY α-amylase, MAMY maltogenic amylase, AMG amyloglucosidase

Conclusions

To conclude, an increment in the damaged starch content changed dramatically dough-mixing properties, pasting profile and dough stickiness demonstrating the significance of damaged starch levels in determining flour properties. In general, addition of amylases and their mixtures modified dough-mixing properties and pasting profile of partially damage starch flour demonstrating amylase functionality in processing starch containing foods.

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