

VARIABILITY OF CRUMB GRAIN IN BREAD FROM INDUSTRIAL PRODUCTION

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D. Magdić¹, M. Jakić¹, D. Horvat², J. Lukinac¹, M. Brođanac³

¹Josip Juraj Strossmayer University of Osijek Faculty of Food Technology Osijek

²Agricultural institute Osijek

³"Crown" - Bakery factory Osijek

ABSTRACT

Differences in appearance of finalized bakery products can be obtained even if standardized production is leaded and managed by computer. The aim in this research was to determine crumb grain and its change during bread production based on the same flour with constant process parameters and recipes. In experimental part of this work bread samples called "Bijeli", "Primorski" and "Miješani kukuruzni" from regular market during 12 days were analyzed. Total gas cell area (TCA) was determined on bread slices by digital image analysis method and obtained data were processed and presented by tables and graphically. Results showed that bread sample called "Bijeli" had 17.26% TCA in average; "Primorski" had 21.81% while bread called "Miješani kukuruzni" had 28.38% TCA. In spite of constant parameters total gas cell area during mentioned period differs from 47.57% in bread called "Bijeli", 41.06% in bread called "Primorski", to 48.35% in bread called "Kukuruzni miješani".

Key words: bread, crumb grain, image analysis

INTRODUCTION

Evaluation of bread properties can be aided partially by image analysis methods that combine techniques for computing statistics of pixel properties. The main crumb texture attributes can be evaluated by computer applications based on different algorithms. In evaluation of these visual attributes, image analysis has been confirmed as an objective and highly confident method and in last decades it has become almost a standard crumb structure evaluation method. Images of bread samples and obtained results can be stored and compared with other results from previous or next researches [1-7].

In this research impact of standardized production on crumb texture appearance was analyzed.

MATERIAL AND METHODS

Bread types Bijeli, Primorski and Miješani kukuruzni from different flour types were analyzed for twelve days. Bread called Bijeli was produced from wheat flour mix of type T-500 and steamed flour of type T-500 and was very elastic. Primorski was produced from wheat flour type T-550 and was extremely soft, elastic and fresh. Miješani

kukuruzni was produced from flour mix of ordinary, steamed and extruded corn flour with wheat flour of type T-850, was prepared in baskets and were had aroma as cooked maize.

Bread loaves for every bread type were randomly chosen from bakery store, were cut three times and six crossover sections (slices) were imaged and analyzed.

Table 1. Applied baking parameters

Bread types	Fermentation (min)			Baking temperature (°C)	Baking time (min)
	In mass	In loaf & chamber	Out of chamber		
Bijeli	15	50	-	240	33
Primorski	45	45	-	235	38
Kukuruzni miješani	10	60	-	210	45

Image analysis

Three different bread types (six slices from every loaf) were cut and image analysis for 216 slices during this research was done. Slices were illuminated by halogen indirect illumination (760±5 lux) and images were captured by digital camera. Image analysis was done by Global Lab Image/2 computer application [8]. Total slice area (mm²), slice height and diameter (mm), h/d ratio also as total gas cell area on slices (%) were determined. Optimum threshold value for every bread type was determining on daily basis. Threshold was moved until gas cells smaller than 1 mm² was became invisible on images.

RESULTS

Table 2. Image analysis results (Bijeli, N=72)

	Slice area (mm ²)	Height (mm)	Diameter (mm)	h/d ratio	TCA (%)
Avg	17403.42	120.44	173.29	0.70	17.26
Min	6953.64	74.44	113.33	0.60	6.48
Max	26029.08	146.67	223.70	0.79	44.74
STD	3768.36	14.70	21.56	0.05	8.21
C.V. (%)	21.65	12.21	12.44	6.74	47.57

Mean C.V. for all parameters from table 3 calculated to be 20.12%. Correlation coefficients for bread type Bijeli (N=72) between slice area and TCA (-0.1997), -diameter (0.9689), height (0.9386) and h/d (-0.0327) were as listed.

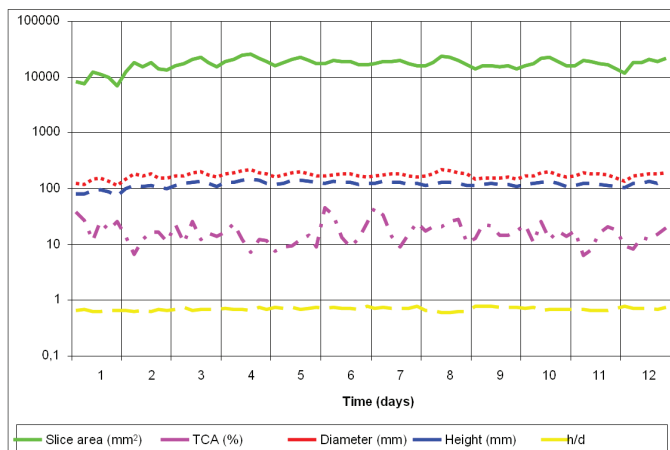


Figure 1. Changes of bread loaves and crumb texture (Bijeli, N=72)

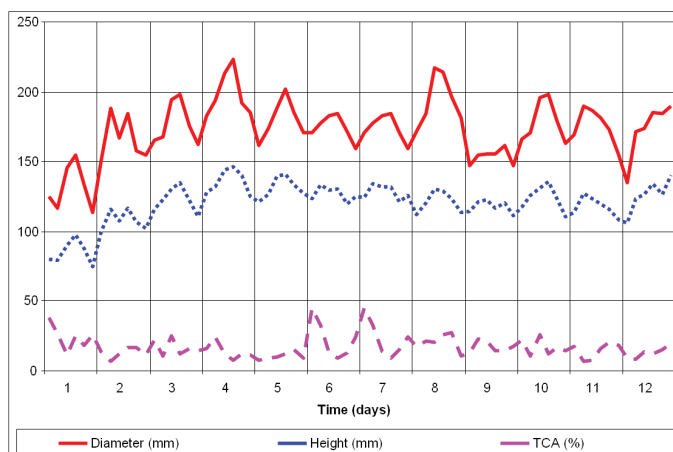


Figure 2. Changes of height, diameter and TCA (Bijeli, N=72)

Table 3. Image analysis results (Primorski, N=72)

	Slice area (mm ²)	Width (mm)	Height (mm)	h/w ratio	TCA (%)
Avg	16107.02	211.06	96.60	21.81	0.46
Min	6791.77	142.96	58.89	5.61	0.34
Max	23038.68	262.96	194.81	55.06	1.01
STD	3919.67	27.39	18.76	8.95	0.08
C.V. (%)	24.34	12.98	19.43	41.06	17.70

Mean C.V. for all parameters calculated to be 23,10%. Correlation coefficients for

bread type Primorski (N=72) between slice area and TCA (-0.1613), diameter (0.9150), height (0.7108) and h/d (0.1523) were as listed.

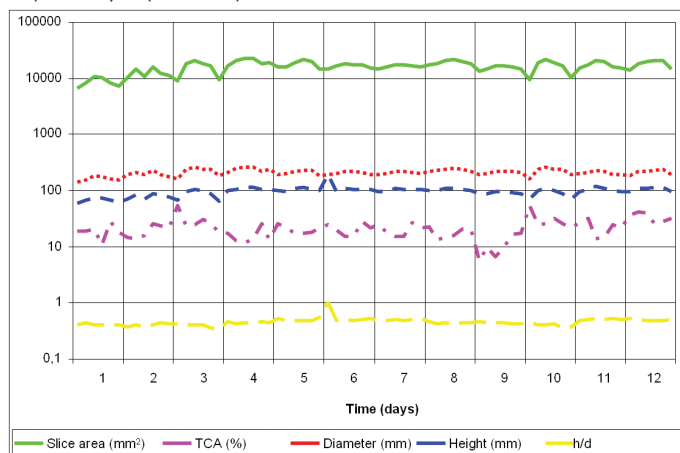


Figure 3. Changes of bread loaves and crumb texture (Primorski, N=72)

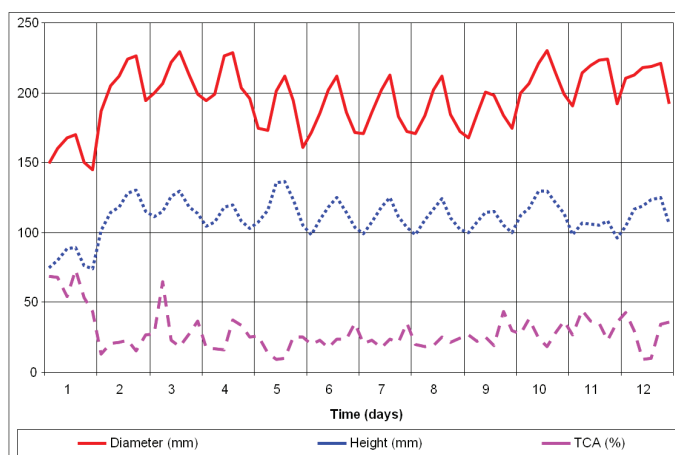


Figure 4. Changes of height, diameter and TCA (Primorski, N=72)

Table 4. Image analysis results (Miješani kukuruzni, N=72)

	Slice area (mm ²)	Width (mm)	Height (mm)	h/w ratio	TCA (%)
Avg	17680,13	196,14	110,56	28,38	0,56
Min	8291,08	144,44	74,07	8,82	0,47
Max	24377,09	230,00	136,30	73,06	0,67
STD	3848,01	21,35	13,34	13,72	0,04
C.V. (%)	21,76	10,88	12,06	48,35	7,46

Mean C.V. for all parameters calculated to be 20,10%. Correlation coefficients for bread type Miješani kukuruzni (N=72) between slice area and TCA (-0.5887), diameter (0.9033), height (0.9197) and h/d (0.1990) were as listed.

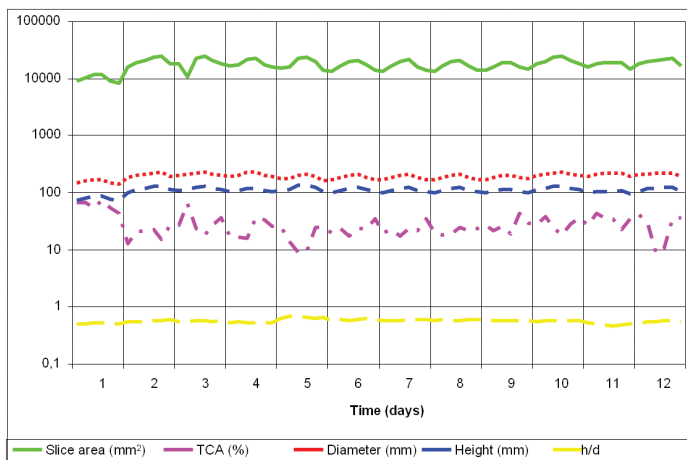


Figure 5. Changes of bread loaves and crumb texture (Miješani kukuruzni, N=72)

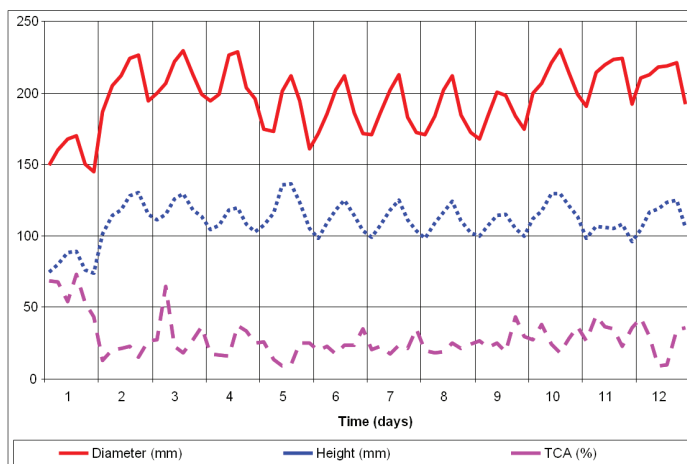


Figure 6. Changes of height, diameter and TCA (Miješani kukuruzni, N=72)

CONCLUSIONS

Bread Bijeli had the lowest total cell area (TCA=17.26%) and the highest h/d ratio (0.70). Bread Primorski had the biggest single cells (in accordance with product declaration). Bread Miješani kukuruzni had the lowest loaf mass, the biggest slice area (17680.13 mm²) and the biggest total cell area (TCA=28.38%). There was no

significant correlation between slice area and total cell area for any analyzed bread. From calculated coefficient of correlation can be concluded that size of slices did not influence on cells number, size and appearance. The graphic overview showed that the variability of all analyzed parameters was negligible respecting their periodically appearance. The average parameter variability on analyzed bread slices was found to be 21.11%. It is too small variability and can not be noticed by consumers. Threshold values were chosen to be optimum for specific bread type.

Future research will be directed in analyzing of crumb texture appearance in bread produced from different wheat cultivars.

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