Scientific Bulletin. Series F. Biotechnologies, Vol. XX, 2016
ISSN 2285-1364, CD-ROM ISSN 2285-5521, ISSN Online 2285-1372, ISSN-L 2285-1364

PHYSICO-CHEMICAL AND MICROBIOLOGICAL CHARACTERIZATION OF WHEAT FLOURS ON ROMANIAN MARKET IN RELATION TO THE SHELF LIFE

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Abstract

This paper aims to assess the quality and microbiological parameters of a range of wheat flours for domestic consumption, purchased on the Romanian market. In this regard there were purchased 20 samples of flour from 13 manufacturers. Quality parameters analyzed were: Moisture (%), Protein content (%), Ash content (%), Water absorbtion (%), Total *combined* Yeasts and Molds count *(CFU/g) and the number of days until the deadline of the shelf life. The analyzed flours were characterized by the following variation ranges of the parameters: Moisture (%) 10.9 - 14.4, Protein content (%) 10.0 - 15.7, Ash content (%) 0.40 - 1.59, Water absorbtion (%) 57.0 - 61.9, Yeast and molds (CFU/g): 10-410, and number of days until the deadline of the shelf life: 9-326. The results showed that there are no significant correlations between analyzed parameters and the content of yeasts and molds. This suggests that the dynamics of yeasts and molds population in packed flours is dependent primarily on the processing conditions and less on the factors that act during the lifetime of the product on the shelf.*

Key words*: molds, quality parameters, wheat flour, yeast.*

INTRODUCTION

Romania is one of the countries where consumption of milling and bakery products recorded a value above the EU average. In the year 2013 this consumption was estimated at 101.4 kg /person [5]. This value is approximately 30% higher than the European average, estimated at about 75-80 kg/year [4]. The total quantity of flour used in households was 7.3 kg/person/year. Romanian wheat crops are characterized by a large annual variability of the main quality parameters [3]. This fact is reflected in significant variations of the main flour quality parameters. Grinding traditional technologies, common to most mills in Romania, do not provide specific process steps to reduce microbial load. Reduction of microbial load in raw material to finished products is a natural consequence of processes like cleaning and conditioning the feedstock, followed by grinding and separating the outer layers of wheat grain. It is estimated that the degree of reduction of microbial load is about 10-100 times (1-2 log) in the process of grinding [1, 2].

Romanian legislation does not provide obligatory criteria on flours microbial load. The National Sanitary-Veterinary Agency for Food Safety ordinance no. 27/2011 recommend a maximum of 1000 CFU/g yeasts and molds for white flour, but introduces a validation criteria for batches of flour (three of the five samples must be below 100 CFU/g) [6]. In this context, we characterized different types of flour used for household consumption, in terms of physico-chemical and microbiological aspects, in relation to the shelf life.

MATERIALS AND METHODS

20 samples of flour were purchased in November 2015, from several supermarkets in Bucharest. Flour samples were processed by the following manufacturers: Farinsan S.A. (2 samples), Sano Vita (1 sample), Bio Logistic Romania (1 sample), Good Mills Romania (5 samples), Boromir (2 samples), Pivetti Italy (1

sample), Pambac (2 samples), Arpis (1 sample), 7 spice (2 samples), Liszt Agro Monar (1 sample) and Băneasa SA (2 samples).
From a technological viewpoint the 20 samples were part of the following categories: whole flour 2 samples, black flour 1250 - 2 samples, flour type 00 - 1 sample, flour type 650 -6 samples, flour type 480 - 1 sample, flour type 000 - 7 samples and flour type 550 - 1 sample.
For each of the samples were determined the following parameters: Moisture (M, %; using KERN MLB 50-3thermobalance, at 130^0C), Ash content (Ash, %; SR ISO 2171/2009), Protein content (P, %; ICC 159-95 - NIR method, PertenInframatic 8600), Water absorbtion (WA, %; SR ISO 5530-1/2007, Brabender Farinograph E), Total combined Yeasts and Molds count (TYMC/CFU) (ISO 21527-2 SR / 2009).
The period of time until the deadline ofthe shelf life (SL, days) was calculated according to the data inscribed by the manufacturer on the package, starting from the day of microbiological analysis effectuation.

RESULTS AND DISCUSSIONS

The results from the analyzes performed on 20 samples of flour are shown in Table 1.

Table 1.The determined values and the variability estimates of quality parameters for 20 types of flour

Sample no.	M(%)	P (%)	Ash (%)	WA (%)	TYMC (CFU/g)	SL (days)
1. (Whole flour)	11.8	10.9	**1.21**	59.5	10	119
2. (Whole flour, eco)	11.8	10.9	1.59	61.9	170	250
3. Black wheat flour type 1250	11.9	15.7	1.08	60.2	150	89
4. Black wheat flour	11.7	13.8	**0.96**	59.3	110	29
5. Type 00 flour	10.9	12.2	**0.57**	60.7	20	287
6. Type 650 wheat flour	12.6	10.6	0.62	57.8	80	188
7.Type 650 wheat flour	11.4	12.2	0.62	59.2	140	9
8. Type 650 wheat flour	13.2	11.6	0.63	58.2	150	119
9. Type 650 wheat flour	14.4	10.7	**0.71**	57.1	400	128
10. Type 650 wheat flour	13.3	10.8	0.63	57.4	20	201
11. Type 650 wheat flour	12.9	10.1	**0.51**	58.0	298	108
12. Type 480 wheat flour	13.3	10	**0.53**	57.0	30	188
13. Type 000 wheat flour	12.9	10.9	0.4	59.7	10	174
14. Type 000 wheat flour	13.4	10.6	**0.59**	57.5	120	326
15. Type 000 wheat flour	14.4	11	**0.51**	57.9	50	122
16. Type 000 wheat flour	11.7	10.5	0.46	58.3	10	69
17. Type 000 wheat flour	12.5	12.2	**0.58**	59.4	30	103
18. Type 000 wheat flour	13.1	11.6	**0.53**	58.6	20	189
19. Type 000 wheat flour	13	10.45	0.48	58.8	410	113
20. Type 550 wheat flour	13	13.3	0.55	61.2	160	110
Descriptive statistics						
Mean	12.660	11.502	0.688	58.885	119.40	146.050
Standard deviation	0.942	1.415	0.297	1.372	123.45	80.117
Coeff. of variation (%)	7.441	12.302	43.169	2.328	103.39	54.856

We can see in table 1, that the abnormal values of the quality parameters in relation to the flour type were highlighted (bold). We observed that 50% of the flour samples did not comply the characteristic values of Ash parameter. Thus, sample 1 (whole flour) had a value of 1.21% ash, to a minimum permitted of 1,4 - 1,5% that is a characteristic value for the whole flour. Sample 4 (black flour) had a smaller value of ash content (0.96%), compared to a minimum

permitted of 1.2%. The flours type 00, type 000 or 480 (samples 5, 12, 14, 15, 17, 18) exceeded the value of 0.5%, that is accepted for these flour types. Flour sample no. 9 had an ash value of 0.71% compared to a max. of 0.67% characteristic for 650 flour type. Regarding sample no 11, 650 flour type, it looks like the ash value was far below the minimum characteristic for this type of flour (0.51% toward 0.63%).

There is therefore a major tendency to overestimate 000 and 480 flour type, sold on the Romanian market, because two thirds of the samples did not respect the criteria of ash value, specific to the type of flour on the package. The phenomenon is less extensive in the case of higher extraction flours (type 650 and above), although in the case of sample 1, a black flour is sold as a whole flour.

In table 1 it is observed that analyzed flours were characterized by low Moisture variability (mean 12.66% ± 0.94), in the range of 10.9 - 14.4%.The Protein content had a medium degree of variation (mean 11.5% ± 1.41), in the range of 10.0 - 15.7%.The Ash content was the quality parameter that reflected the best the heterogeneity of the sample, being characterized by an average of 0.69% ± 0.30 (in the range 0.40-1.59%). The Water absorbtion of the flours (mean 58.9% ± 1.37) was the parameter with the lowest variability in the analyzed samples, between57.0 and 61.9%. Total combined Yeasts and Molds count was characterized by significant variability, ranging between 10-410. None of the samples exceeded the limit of 1000 CFU/g recommended by legislation and only 10 samples exceeded the limit of 100 CFU/g. Concerning the number of days until the deadline of the shelf life of the flours, it ranged between 9 and 326.This parameter average was 146 days.

Table 2 presents the linear correlation coefficient values between the analyzed parameters of the flour samples.

We have observed in table 2 that the only quality parameters of flours that correlated with each other, where Water absorbtion - Moisture (r = -0.62**), Water absorbtion - Protein content (r = 0.53 *) and Water absorbtion - Ash (r = 0.51*). This is a natural relationship between parameters, given that the ability of flour to bind water is the higher the degree of hydration of the flour components is lower and the concentration of elements capable of binding water (protein, fiber) is also higher.

Table 2. The correlation coefficients between the quality parameters

	M (%)	P (%)	Ash (%)	WA (%)	TYMC (CFU/g)	SL (days)
M (%)	1.00					
P (%)	-0.40	1.00				
Ash (%)	-0.39	0.29	1.00			
WA (%)	**-0.62****	**0.53***	**0.51***	1.00		
YM (CFU/g)	0.30	-0.07	0.05	-0.09	1.00	
SL (days)	0.13	-0.36	0.04	-0.00	-0.20	1.00

*p<0.5, semnificative; **P<0.01, distinct semnificative

We see that there are no significant correlations between the number of yeasts and molds and the analyzed quality parameters.No flours Moisture (r = 0.30 ns), nor their Ash content (r = 0.05 ns) did not significantly affect their microbial load with yeasts and molds. It was noted that the number of days until the deadline of the shelf life does not correlate with the degree of microbial load, the correlation coefficient between the two parameters being negative and low (r = -0.2 ns).

These results suggest that the dynamics of the microbial population in flours, rather depends on specific conditions of grinding process and depends less on the factorsthat act on the packaged flours during their shelf life.

CONCLUSIONS

Our results show a significant tendency to overestimate flours type 000 or 480, sold on the Romanian market, two thirds of them do not comply the limitations regarding ash, specific to the type of flour on the package. The phenomenon is less visible to higher extraction flours (type 650 and above), although in our experiment I saw that a black flour was sold as whole flour.

There were no significant correlations between the content of flours yeast and molds and quality parameters, nor between yeasts and molds content of flours and number of days until the deadline of the shelf life. Our results lead to the conclusion that the dynamics of microbial population in flour is depending on grinding, generally on technological conditions

for obtaining flour and less on factors acting during their shelf life.

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