Changes in Potato after Different Thermal Processes

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Abstract: Undesirable thermal processes or storage conditions lead to physical and chemical quality loss of every food. The objective of this study was to determine the total solid content, starch, reducing sugars, nitrates and nitrites in raw and thermal processed red and white potato samples purchased from different geographic origin in Croatia. The potatoes were processed with and without the skin, and cooking processes were carried out in classic way, in the pressure cooker and in the microwave oven. Standard methods of analysis for above-mentioned parameters were used. The results showed no significant influence ($P < 0.05$) of the geographic origin on investigated parameters in raw samples (except for nitrates), but there were significant differences ($P < 0.05$) in composition between the kinds of samples (red and white). Thus, samples of white potato had higher total solids, starch and reducing sugars content than red potato samples, while red potatoes had higher nitrites and nitrates content. Thermal treatment showed that the total solid content is higher in potatoes processed with skin then those processed without the skin. The starch content in both kinds of potatoes increased after thermal processes if potato was processed without skin. The content of reducing sugars was the highest in samples of raw potato. The nitrites and nitrates content were decreasing during thermal treatments. Thermal processing (classic way, under pressure or with microwaves) and the manner on which the potatoes were cooked (with or without skin) significantly influenced on all investigated parameters especially in red potatoes samples.

Keywords: potato; cooking methods; quality

INTRODUCTION

During cooking a number of changes occur in potato tuber. The nature and magnitude of these changes influence the quality of cooked potatoes. For instance some cooking conditions may cause excessive quality loos due to the breakdown of the cellular material such as pectin. For potato processing especially for the production of French fries and chips, the most popular products on Croatian market, reducing sugars contents are very important, as reducing sugars negatively affect product colour and taste.

Many investigations were done about effect of storage conditions (temperature, light, or time) and variety on the compositional parameters in potatoes [1–6] or effects of culinary processing on them [1, 7–17]. None of them was from Croatia although potatoes had significant role in Croatian nutrition. Therefore in this study dry matter, reducing sugars, starch, nitrate and nitrite content were determined in fresh raw potato samples and potato samples after culinary processing, focusing on the influence of geographic origin of potatoes, types of potatoes, used cooking methods and effects of peeling.

EXPERIMENTAL

Materials and methods. Two types of potatoes (red and white) each of them from 5 different geographic origins (Čakovec, Gospić, Ogulin, Sisak and Vinkovci) were purchased on market. Three different cooking methods (boiling in a pot of water, boiling in a pressure cooker and microwaved using boiling water) and effect of peeling were used. Fresh raw samples and samples after cooking were analysed using standard methods of analysis [18–20].

RESULTS AND DISCUSSION

Raw, white potato samples contained 19.98% dry matter, 12.43% starch, 1.54% reducing sugars, 1.10 mg/kg nitrites and 6.45 mg/kg nitrates in av-

Table 1. Chemical parameters in raw potato samples

Geographic origin	Type of potatoes	Dry matter (%)	Starch (%)	Reducing sugars (%)	Nitrites (mg/kg)	Nitrates (mg/kg)
Čakovec	White	22.43	14.51	1.14	0.267	2.439
	Red	18.14	10.47	1.73	2.954	8.943
Gospić	White	21.40	11.63	1.45	1.035	3.471
	Red	19.66	10.54	1.14	4.635	11.828
Ogulin	White	19.66	12.34	1.18	0.139	10.789
	Red	18.31	9.81	2.17	6.710	20.428
Sisak	White	18.77	11.56	2.08	0.651	6.991
	Red	17.95	11.64	1.53	4.926	12.858
Vinkovci	White	17.66	12.11	1.86	3.405	8.538
	Red	19.74	10.32	1.64	3.983	10.495

erage. Raw, red potato had lower dry matter and starch content (18.76% and 10.56% in average) and higher reducing sugars content, nitrites and nitrates content (1.64%, 4.64 mg/kg and 12.87 mg/kg in average, respectively) – Table 1. No significant variations ($P < 0.05$) were observed in investigated parameters inside each type of potatoes (except for nitrates content) but there were significant differences in parameters ($P < 0.05$) between types of potatoes. From toxicological point of view the amounts of nitrites and nitrates in red potatoes samples were 2–4 times higher then in white potatoes but established concentrations were negligible or similar in comparison with literature data [8, 11, 12, 21].

Effects of various cooking procedures, effect of peeling, effect of type and geographic origin of samples on each analysed compositional parameter are shown in Tables 2 and 3.

After cooking almost all samples had lower dry matter content. In comparison the used cooking methods dry matter contents were higher in both types of non-peeled potatoes samples especially after cooking in pressure cooker. The lowest dry matter content was established in peeled potato samples also after cooking under pressure.

Starch content was varied regarding to cooking methods. Generally non-peeled potato samples had lower starch content that peeled ones.

During cooking the reducing sugars content decreased in all investigated samples. The higher concentrations were determined in non-peeled samples after cooking by newer cooking techniques (pressure cooker or microwaved). Samples boiled in a pot had the smallest reducing sugars contents.

The nitrites and nitrates content were decreased during cooking. The highest nitrites and nitrates

Table 2. Dry matter content in potato samples after culinary processing

Geographic origin	Type of potatoes	Cooking methods					
		Pot		Pressure cooker		Microwaved	
		Peeled	Non peeled	Peeled	Non peeled	Peeled	Non peeled
Čakovec	White	21.31	16.66	15.79	21.43	17.87	19.89
	Red	14.83	20.06	16.92	24.43	16.98	20.20
Gospić	White	18.66	15.80	15.80	19.68	20.60	15.69
	Red	16.76	20.42	17.84	22.70	14.53	19.77
Ogulin	White	16.76	20.57	18.37	18.76	17.88	24.76
	Red	14.89	20.77	17.54	22.63	14.75	19.58
Sisak	White	23.35	17.66	14.68	17.18	15.68	18.64
	Red	17.66	21.37	15.83	20.88	16.36	19.55
Vinkovci	White	17.66	19.75	14.27	16.26	16.26	22.35
	Red	17.96	21.65	16.23	22.68	16.86	20.83

Table 3. Starch, reducing sugars, nitrites and nitrates contents in potato samples after culinary processing

Geographic origin	Type of potatoes	Cooking methods					
		Pot		Pressure cooker		Microwaved	
		Peeled	Non peeled	Peeled	Non peeled	Peeled	Non peeled
Starch content							
Čakovec	White	12.17	12.66	14.89	11.69	12.83	10.79
	Red	12.47	10.67	16.13	10.82	11.78	10.88
Gospić	White	14.23	13.13	15.30	12.43	13.23	12.84
	Red	14.32	12.04	13.24	10.92	12.63	11.32
Ogulin	White	14.22	11.54	14.18	12.63	15.34	13.42
	Red	14.43	11.32	13.22	11.56	10.94	10.24
Sisak	White	10.84	12.35	11.83	10.99	10.23	11.63
	Red	13.85	12.85	13.76	13.06	13.37	11.73
Vinkovci	White	12.11	12.18	10.98	9.60	10.78	12.13
	Red	13.42	10.56	14.74	13.03	14.54	11.23
Reducing sugars content							
Čakovec	White	0.80	1.17	1.64	1.96	1.01	1.17
	Red	1.07	1.13	0.68	1.42	1.02	1.07
Gospić	White	0.68	0.70	0.70	1.57	1.00	1.13
	Red	0.51	0.68	0.82	0.91	0.76	0.83
Ogulin	White	1.86	1.06	0.97	0.62	0.61	0.73
	Red	0.94	1.39	1.17	1.34	1.62	1.82
Sisak	White	1.12	0.94	0.83	1.04	0.78	0.76
	Red	0.48	0.65	0.61	0.92	1.32	1.50
Vinkovci	White	1.36	1.05	1.18	1.45	1.52	1.64
	Red	0.95	1.36	0.84	1.43	1.44	1.62
Nitrites content							
Čakovec	White	1.163	1.099	3.213	2.188	1.163	1.395
	Red	0.892	1.052	1.568	1.863	1.496	1.754
Gospić	White	5.134	1.804	2.188	1.331	1.484	1.099
	Red	0.974	1.328	2.724	3.180	2.638	3.068
Ogulin	White	0.651	1.035	2.572	4.749	2.188	3.651
	Red	1.686	2.243	3.606	4.385	3.568	4.206
Sisak	White	0.459	0.267	2.188	2.893	2.188	1.484
	Red	1.083	1.512	2.851	3.264	2.723	3.185
Vinkovci	White	0.651	0.523	4.045	3.533	4.942	6.395
	Red	1.156	1.354	2.562	2.814	2.493	2.753
Nitrates content							
Čakovec	White	2.627	6.375	1.401	6.126	4.034	7.345
	Red	2.546	2.859	7.938	8.643	7.883	8.485
Gospić	White	6.943	4.034	2.064	4.316	3.659	4.439
	Red	2.963	3.455	10.653	11.424	10.492	11.253
Ogulin	White	3.190	3.970	3.248	8.069	10.321	5.160
	Red	5.926	6.641	18.534	19.864	18.736	19.596
Sisak	White	2.572	3.891	5.198	4.494	3.277	2.893
	Red	3.286	3.862	11.432	12.384	11.316	12.096
Vinkovci	White	9.758	9.634	7.881	6.755	2.721	11.635
	Red	3.092	3.564	9.421	10.156	9.385	10.094

contents were established in both types of non-peeled potatoes after cooking in pressure cooker, while the smallest amounts were determined in both types of peeled potatoes boiled in a pot. From toxicological point of view minimal daily intake of nitrites and nitrates will be obtained eating peeled potatoes cooking in a pot using boiling water.

CONCLUSIONS

Generally, all investigated compositional parameters decreased during cooking especially when potatoes were peeled.

Dry matter content was higher in non-peeled potato samples after cooking in pressure cooker.

The starch content in both types of potatoes increased after cooking if potatoes were cooked peeled.

Reducing sugars content was the highest in raw potato samples. After cooking maximum levels were observed in non-peeled potato samples cooked under pressure or by microwaves.

The nitrites and nitrates content were lower after cooking. Greatest losses occurred during cooking in a pot both types of peeled samples.

The ANOVA showed that cooking methods and effect of peeling significantly influenced ($P < 0.05$) on all investigated parameters.

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