INFLUENCE OF MACERATION PARAMETERS ON PHYSICOCHEMICAL PROPERTIES OF CAROB MACERATES

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1. Introduction

Carob liqueur is a strong alcoholic drink produced by maceration of carob pods with hydro-alcoholic base (commonly grape-marc distillates), typicall for the Mediterranean countries. During the maceration process, various compounds that give a characteristic flavor and colour as well as the biologically active compounds are extracted from carob pods into the hydro-alcoholic base. Among them the most important are polyphenols which have many health benefits due to their antioxidant, antidiabetic and anti-inflammatory activities. In order to extract polyphenols as much as posible the optimization of carob pod maceration parameters is required.

The aim of this study was to investigate the influence of the maceration process parameters on the total polyphenolic content, the antioxidant activity and chromatic parameters of the carob macerates. The maceration time (1 to 4 weeks), the ratio of plant:hydro-alcoholic base/solid:liquid (1:5 and 1:10), ethanol content (30, 50 and 70 %), and the exposure to sunlight or darkness were the studied parameters.

2. Materials and methods

Preparation of carob macerates

Carob macerates were prepared by the maceration of chopped carob pods in hydro-alcoholic base. Carob pods were macerated in 500 mL of hydro-alcoholic base (30, 50 and 70 % v/v of ethanol) in different solid to liquid ratio (1:5 and 1:10) at room temperature exposed to sunlight as well to darkness. Samples were obtained after 1, 2, 3 and 4 weeks of maceration.

Determination of total polyphenol content (TPC) and antioxidant activity

Determination of the total polyphenol content (TPC) in samples has been conducted by the Folin-Ciocalteu method. The results are expressed as g of gallic acid equivalents (GAE) per 100 mL of carob macerate (Figure 1). For the determination of antioxidative activity of carob macerates, the DPPH radical scavenging activity and ferric ion reducing antioxidant power (FRAP) were used. Results are expressed as % of inhibition of DPPH radical (Figure 2) and as mM of Trolox for FRAP (Figure 3).

Chromatic characteristics

The chromatic characteristics of carob macerates were determined on a Specord 50 Plus (Analytik Jena, Jena, Germany) in a 10 mm glass cell, by measuring the transmittance of the sample every 10 nm from 380 to 770 nm, with a D65 illuminant. Based on the transmittance values, according to the International Commission on Illumination (CIE) specifications folowing parameters were calculated: luminosity (L*), saturation (C*), chromaticity coordinates (a* and b*) and hue (h*) (Table 1 and 2).

3. Results

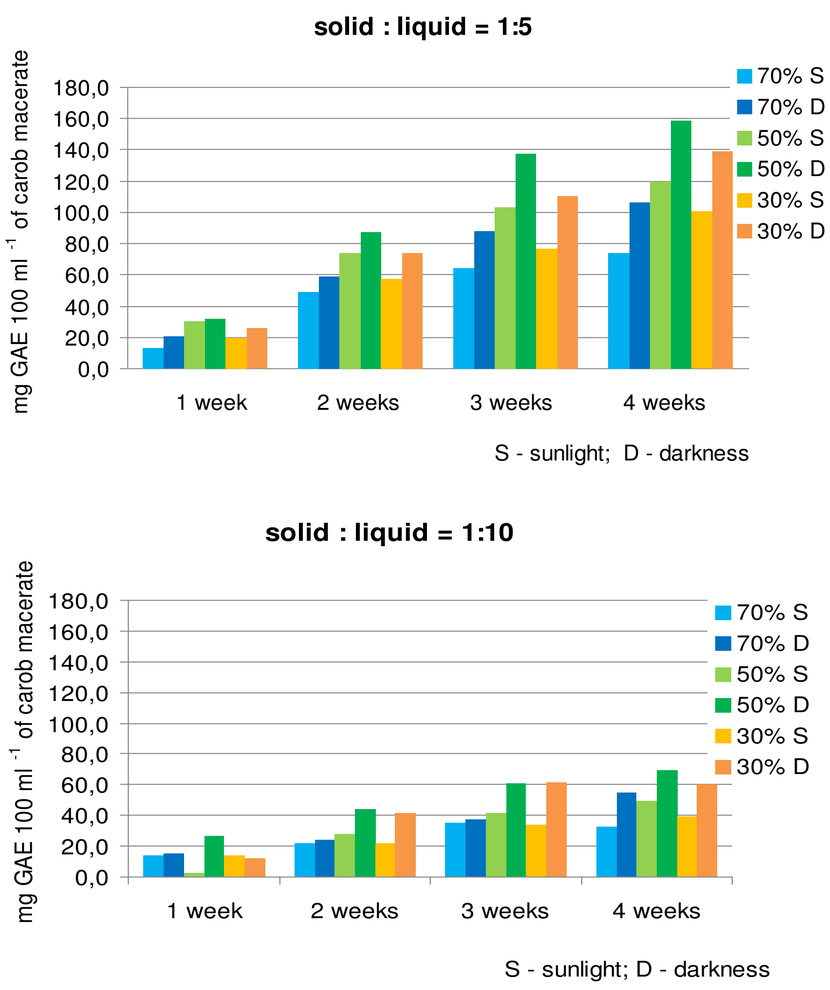

Figure 1. TPC (mg GAE 100 mL^{-1} of carob macerate) in samples (solid:liquid= 1:5 and 1:10) exposed to sunlight and darkness after 1, 2, 3 and 4 weeks of maceration

Table 1. Chromatic characteristics (a*, b*, L*, C*, h*) of samples exposed to sunlight after 1, 2, 3 and 4 weeks of maceration

Samples	a*	b*	L*	C*	h*
1 week					
70% 1:5	-1.35	10.31	97.13	10.40	-1.44
70% 1:10	-0.97	5.57	100.54	5.66	-1.40
50% 1:5	-1.33	19.34	94.75	19.39	-1.50
50% 1:10	-0.94	8.69	97.74	8.74	-1.46
30% 1:5	-1.03	9.21	97.59	9.26	-1.46
30% 1:10	-1.27	16.52	95.09	16.57	-1.49
2 weeks					
70% 1:5	-1.91	16.87	96.31	16.98	-1.46
70% 1:10	-1.31	10.18	97.44	10.26	-1.44
50% 1:5	-0.54	30.04	91.27	30.05	-1.55
50% 1:10	-1.12	14.27	96.11	14.31	-1.49
30% 1:5	-1.23	15.57	95.67	15.61	-1.49
30% 1:10	-1.22	24.57	93.52	24.60	-1.52
3 weeks					
70% 1:5	-1.73	22.47	94.43	22.54	-1.49
70% 1:10	-1.61	13.79	96.68	13.88	-1.45
50% 1:5	1.46	37.89	89.00	37.92	1.53
50% 1:10	-0.99	19.80	94.72	19.83	-1.52
30% 1:5	-1.08	20.99	94.04	21.02	-1.52
30% 1:10	0.11	32.08	90.68	32.08	1.57
4 weeks					
70% 1:5	-1.25	25.78	93.65	25.81	-1.52
70% 1:10	-1.27	15.76	95.82	15.81	-1.49
50% 1:5	3.71	42.63	86.42	42.79	1.48
50% 1:10	-0.49	23.76	93.32	23.76	-1.55
30% 1:5	-0.67	26.09	92.39	26.10	-1.55
30% 1:10	1.88	37.43	88.39	37.48	1.52

Table 2. Chromatic characteristics (a*, b*, L*, C*, h*) of samples exposed to darkness after 1, 2, 3 and 4 weeks of maceration

Samples	a*	b*	L*	C*	h*
1 week					
70% 1:5	-2.36	13.80	97.57	14.00	-1.40
70% 1:10	-1.06	7.09	98.26	7.17	-1.42
50% 1:5	-1.56	21.01	95.08	21.06	-1.50
50% 1:10	-1.61	20.82	94.89	20.88	-1.49
30% 1:5	-1.61	20.73	95.16	20.79	-1.49
30% 1:10	-1.08	13.75	95.44	13.79	-1.49
2 weeks					
70% 1:5	-3.22	22.82	96.02	23.04	-1.43
70% 1:10	-1.79	12.05	97.77	12.19	-1.42
50% 1:5	-0.09	35.57	90.76	35.57	-1.57
50% 1:10	-1.55	21.31	94.59	21.37	-1.50
30% 1:5	-0.71	33.05	91.55	33.06	-1.55
30% 1:10	-0.91	21.43	94.56	21.45	-1.53
3 weeks					
70% 1:5	-2.70	31.87	93.13	31.99	-1.49
70% 1:10	-2.09	17.41	96.56	17.53	-1.45
50% 1:5	3.80	49.54	85.59	49.69	1.49
50% 1:10	-0.50	28.76	92.61	28.77	-1.55
30% 1:5	2.11	43.31	86.03	43.36	1.52
30% 1:10	0.31	29.04	90.80	29.04	1.56
4 weeks					
70% 1:5	-2.05	36.91	91.07	36.97	-1.52
70% 1:10	-2.13	21.07	95.29	21.18	-1.47
50% 1:5	6.34	54.18	83.36	54.55	1.45
50% 1:10	0.07	32.19	91.54	32.19	1.57
30% 1:5	4.56	49.27	84.36	49.48	1.48
30% 1:10	1.36	33.39	90.14	33.42	1.53

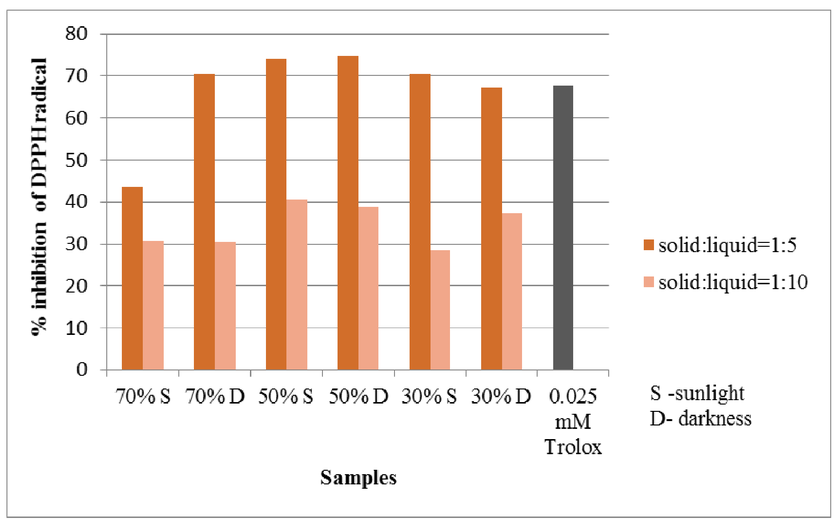

Figure 2. Antioxidative activity (% inhibition of DPPH radical) of samples (solid:liquid= 1:5 and 1:10) exposed to sunlight and darkness after 4 weeks of maceration and 0.025 mM Trolox

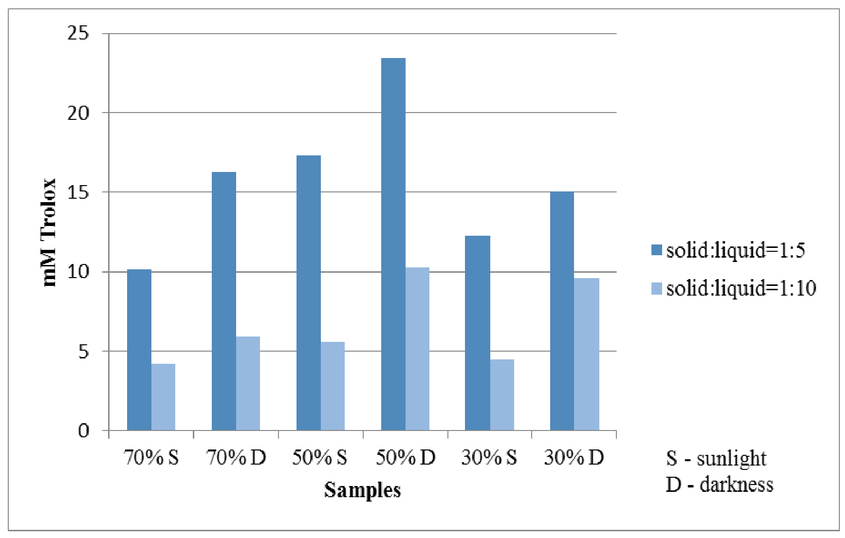

Figure 3. Antioxidative activity (mM Trolox) of samples (solid:liquid= 1:5 and 1:10) exposed to sunlight and darkness after 4 weeks of maceration

4. Conclusions

- **Total polyphenol content (TPC) showed the same pattern in all samples: during maceration the TPC was growing and reached the highest values after 4 weeks of maceration. The highest TPC was observed in the sample produced in darkness with 50% of ethanol in 1:5 (solid:liquid) ratio.**
- **Since the presence of polyphenol compounds significantly contributes to the antioxidative activity of the carob macerates, antioxidative activity of the samples was measured after 4 weeks of maceration. According to the obtained results the highest antioxidative activity using both methods (DPPH and FRAP) was determined in the sample where the highest TPC was observed too.**
- **Significant differences in TPC and antioxidative activity between samples macerated in darkness and samples exposed to sunlight showed that maceration in darkness effectively reduces degradation of bioactive polyphenolic compounds.**
- **The characteristic brown colour of macerates is a result of the maceration process. The amount of carob pods as well as the duration of maceration affected the extraction of pigments. The characteristic colour of macerates ranged from light yellow after 1 week of maceration to brown at the end of maceration (4 weeks).**
- **In order to obtain carob liqueur with functional properties and desirable colour maceration process of carob pods in 50% of ethanol should be conducted in darkness and in 1:5 solid:liquid ratio.**
- **The results of this study will be useful for the liqueur industry when considering which maceration parameters have the greatest influence on the quality of final product.**