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INFLUENCE OF SELECTED ADDITIVES ON COLOUR STABILITY OF ALCOHOLIC EGG LIQUEURS

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Abstract. Addition of anti-oxidative agents into the liqueurs (particularly 0.1% tocopherol) contributes to the reduction of compounds responsible for the product's colour (mainly carotenoids) determined by spectrophotometric means. However, applied modification does not completely inhibit the Advocaate's browning during storage. Components formed during non-enzymatic browning, as a result of Maillard's reaction, are the reason of liqueur's negative colour change. An emulsion prepared from sodium soap, plant oil, distilled water and methyl orange may be a proper standard of egg liqueur colour.

Key words: emulsion creams, colour stability, food additives

INTRODUCTION

Colour is considered to be one of the most important factors of consumer's sensoric evaluation of foodstuff products. Transformations of colour substances during technological processes form the final colour of a product and for many of them, it is a quality indicator [Chemiczne... 1996].

Characteristic yellow colour of egg liqueurs is due to hen's egg yolks and it is relatively unstable. It most often changes as a result of redox processes and intensified activity of oxidoreductase enzymes. The colour change may be also associated with the kinetics of chemical or biochemical reactions, e.g. formation of dark-brown pigments in Maillard's reactions. Occurrence of natural dyes and anti-oxidants as well as concentration of fat droplets in colloid system also significantly affect the colour esthetics of O/W-type liqueurs [Weiss and Liao 2000].

Substances of anti-oxidative character may inhibit degradation of carotene compounds. It was found that carotene decomposition course depends on tocopherol presence. At its absence after 1-hour incubation, only 6% of β-carotene molecules kept their properties, whereas number of native dye molecules reached up to 80% at the presence of anti-oxidant [Philip and Francis 1971, Kyung et al. 2000].

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The aim of present research is to evaluate the browning rate of egg liqueurs during storage and to estimate the efficiency of selected additives applied to increase the Advocaate's colour stability during storage.

MATERIAL AND METHODS

Laboratory sets of liqueurs (250 cm^3) with colour stabilizers were prepared (Table 1). System was homogenized (22 000 rpm, 10 min, homogenizer UltraTurrax T-25 basic) and sugar syrup then ethanol as well as wine distillate and vanilla tincture were added.

Table 1. Addition of stabilizers to analysed samples
Tabela 1. Dodatki stabilizatorów do badanych prób kremu

Stabilizer type Rodzaj stabilizatora	Concentration in emulsion, % m/V Stężenie w emulsji, % m/V
Ascorbic acid – Kwas askorbinowy	0.005; 0.01
Lactic acid – Kwas mlekowy	0.05
Ascorbyl palmitate – Palmitynian askorbylu	0.005
Tertbuthylhydroquinone – Tertbutylohydrochinon	0.005; 0.01
Tocopherol (vit. E) – Tokoferol	0.005; 0.01; 0.05; 0.1
Saturated with nitrogen – Wysycone azotem	—
Control sample – Próba kontrolna	—

Liqueurs were stored for 6 months at ambient temperature with light access. In addition, one sample series was stored in dark place (with no daily light access).

The liqueur's colour was determined during the storage by means of:

– spectrophotometry [Krełowska-Kułas 1993] – liqueur was extracted with acetone, absorbance measurements were made and colour was compared to NEPA grade "National Egg Producer Association" (1° NEPA = absorbance of 5 mg $K_2Cr_2O_7$/100 cm^3 of water solution) by reading from calibration curve plotted for water solutions of potassium dichromate,

– titration using methyl orange – laboratory emulsion (sodium soap, water, plant oil) was titrated with methyl orange solution until the same colour as determined sample.

The result analysis allowed for selecting tocopherol and ascorbic acid as the most efficient agents in respect to emulsion color stability. At subsequent stage, liqueurs were enriched in selected additives in various combinations by introducing also lecithin and sodium caseinate into the Advocaates (Table 2). Evaluation of below traits of samples prepared both under laboratory and industrial conditions (pressure homogenizer – Alfa-Laval SHL 15, 140 bar):

– colour change (color intensity by means of spectrophotometry and visually),

– Maillard's compounds content by spectrophotometric means in samples after extraction with 10% trichloroacetic acid [Guardiola et al. 1995],

– carotene content change dynamics by means of high-performance liquid chromatography (HPLC) in reversed-phase system after extraction with n-hexane [Tee and Lim 1992].

Table 2. Addition of stabilizers to analysed samples
Tabela 2. Dodatki stabilizatorów do badanych prób

Stabilizer type Rodzaj stabilizatora	Concentration in emulsion, % m/V Stężenie w emulsji, % m/V
Control sample – Próba kontrolna	—
Tocopherol/ascorbic acid – Tokoferol/kwas askorbinowy	0.05 / 0.05
Tocopherol/lecithin – Tokoferol/lecytyna	0.05 / 0.125
Tocopherol/sodium caseinate – Tokoferol/kazeinian sodu	0.05 / 0.1
Lecithin/ascorbic acid – Lecytyna/kwas askorbinowy	0.125 / 0.05
Ascorbic acid/sodium caseinate – Kwas askorbinowy/kazeinian sodu	0.05 / 0.1
Tocopherol/ascorbic acid/lecithin – Tokoferol/kwas askorbinowy/lecytyna	0.05 / 0.05 / 0.1
Tocopherol/ascorbic acid/sodium caseinate – Tokoferol/kwas askorbinowy/ kazeinian sodu	0.05 / 0.05 / 0.1
Sodium caseinate/lecithin/tocopherol – Kazeinian sodu/lecytyna/tokoferol	0.1 / 0.125 / 0.05
Sodium caseinate/lecithin/ascorbic acid – Kazeinian sodu/lecytyna/kwas askorbinowy	0.1 / 0.125 / 0.05
Control sample* – Próba kontrolna*	—
Lecithin/tocopherol* – Lecytyna/tokoferol*	0.1 / 0.1
Lecithin/sodium caseinate/tocopherol* – Lecytyna/kazeinian sodu/ tokoferol*	0.1 / 0.1 / 0.1

*Samples set-up in industrial conditions.
*Próby zestawione w warunkach przemysłowych.

Finding the preferred colour standard for Advocaate

Prepared laboratory emulsion (sodium soap, water, plant oil) was poured into the Erlenmeyer's flask (100 cm^3), with various amounts (from 1 to 6.5 cm^3) of methyl orange (0.01% m/V), stirred and subjected to sensoric colour evaluation in a view of consumer's preference (30-person sensoric panel).

RESULTS

On a base of the achieved results from spectrophotometric determinations, gradual colour intensity decrease was observed in all tested emulsions. The most significant color worsening occurred in sample with lactic acid addition (from 2.34° to 1.34° NEPA). Relatively little differences of yellow components (spectrophotometrically determined carotenoid dyes) were found for samples stored with no light access and

previously saturated with nitrogen. Colour of Advocaates with ascorbyl palmitate and tocopherol was similar as those without additives. Furthermore, it was found that the most intensive colour changes occurred during the first two months of storage.

The following stage of experiments aimed to increase the selected anti-oxidants concentration was the continuation of tests leading to efficient protection of compounds determining the liqueur's colour (mainly carotenoids). Ascorbic acid (0.01%), tocopherol (0.05% and 0.1%) as well as tertbuthylhydroquinone (0.01%) were added. Advocaate with no additives prepared under laboratory conditions was the control (Fig. 1).

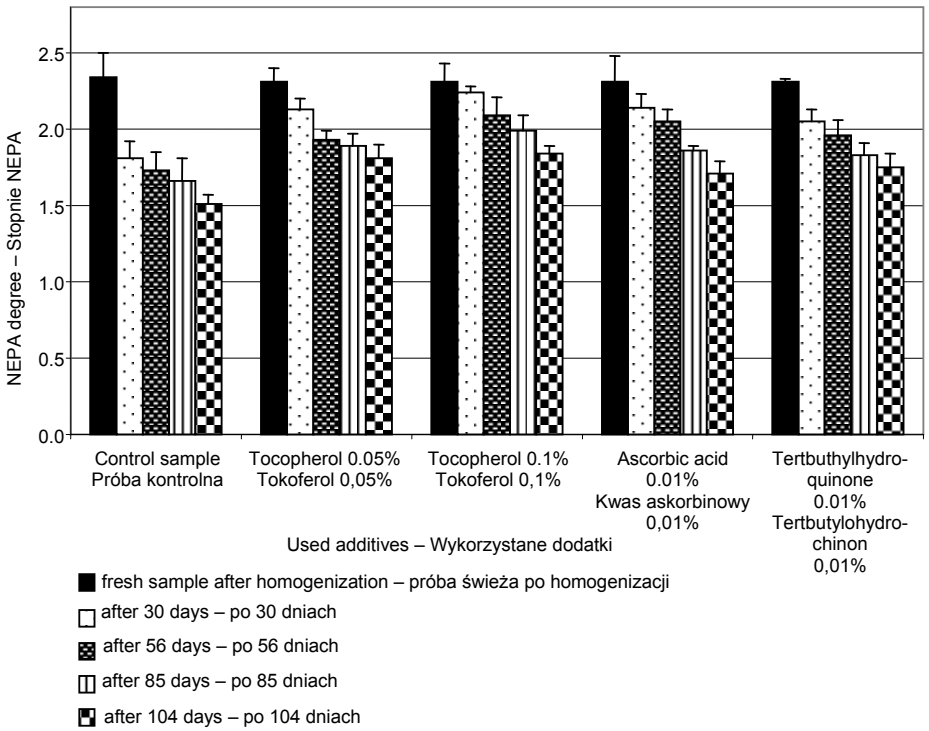


Fig. 1. The influence of storage time on colour intensity changes in creams supplemented with single stabilizing additive
Rys. 1. Zmiany intensywności zabarwienia podczas przechowywania kremów emulsyjnych uzupełnionych pojedynczymi dodatkami stabilizującymi

Higher anti-oxidant concentrations applied at this stage of experiments (Fig. 1) much stronger inhibited dye's decomposition (in reference to preliminary studies). Significant delay of colour change rate of liqueurs containing tocopherol (by about 50%) as compared to the control was recorded. Positive results were also achieved by using tertbuthylhydroquinone and ascorbic acid – reduction of colour compounds degradation amounted to 36% and 28%, respectively, in reference to control.

Visual estimation of liqueur's colour was also performed. Model emulsions were titrated with methyl orange solution (0.01%), until the same colour as analysed sample (Table 3).

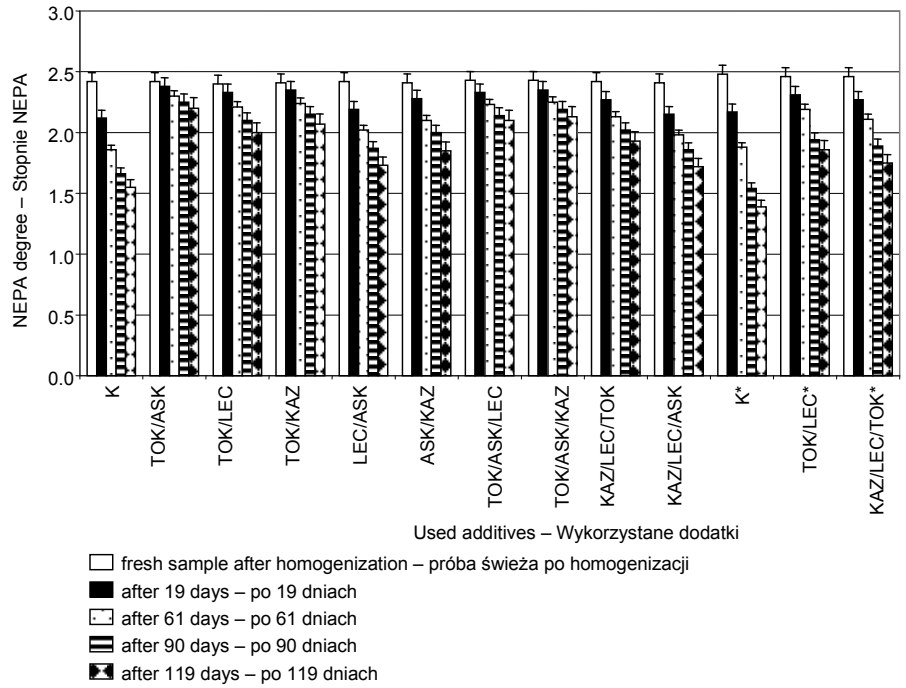
Table 3. Changes of colour intensity in emulsion samples during storage
Tabela 3. Zmiana intensywności zabarwienia badanych prób kremów w czasie przechowywania

Specification Wyszczególnienie	Storage period, days Czas przechowywania, dni				
	0	28	63	93	104
	colour, cm^3 – methyl orange, cm^3 barwa, cm^3 – oranż metylowy, cm^3				
Control sample – Próba kontrolna	4.5 ± 0.3	5.0 ± 0.4	5.5 ± 0.3	5.5 ± 0.4	5.5 ± 0.5
Tocopherol 0.005% – Tokoferol 0,005%	4.5 ± 0.4	5.0 ± 0.3	5.5 ± 0.5	5.5 ± 0.3	5.5 ± 0.4
Tocopherol 0.01% – Tokoferol 0,01%	4.5 ± 0.3	5.0 ± 0.3	5.5 ± 0.4	5.5 ± 0.4	5.5 ± 0.4
Tocopherol 0.05% – Tokoferol 0,05%	4.5 ± 0.3	4.5 ± 0.4	5.0 ± 0.4	5.0 ± 0.2	5.5 ± 0.4
Tocopherol 0.1% – Tokoferol 0,1%	4.5 ± 0.3	4.5 ± 0.2	4.5 ± 0.3	5.0 ± 0.3	5.0 ± 0.3
Ascorbyl palmitate 0.005% Palmitynian askorbylu 0,005%	4.5 ± 0.4	5.0 ± 0.4	5.5 ± 0.4	5.5 ± 0.4	5.5 ± 0.4
Ascorbic acid 0.005% – Kwas askorbinowy 0,005%	4.5 ± 0.3	5.0 ± 0.3	5.5 ± 0.5	5.5 ± 0.3	5.5 ± 0.4
Ascorbic acid 0.01% – Kwas askorbinowy 0,01%	4.5 ± 0.3	5.0 ± 0.5	5.5 ± 0.4	5.5 ± 0.4	6.0 ± 0.5
Lactic acid 0.05% – Kwas mlekowy 0,05%	4.5 ± 0.3	5.0 ± 0.3	5.5 ± 0.3	5.5 ± 0.3	5.5 ± 0.4
Tertbuthylhydroquinone 0.005% Tertbutylohydrochinon 0,005%	4.5 ± 0.3	5.0 ± 0.4	5.5 ± 0.4	5.5 ± 0.4	5.5 ± 0.4
Tertbuthylhydroquinone 0.01% Tertbutylohydrochinon 0,01%	4.5 ± 0.4	5.0 ± 0.3	5.5 ± 0.2	5.5 ± 0.4	5.5 ± 0.3
Nitrogen – Azot	4.5 ± 0.3	5.0 ± 0.2	5.5 ± 0.4	5.5 ± 0.5	5.5 ± 0.4
With no daily light access – Bez dostępu światła	4.5 ± 0.3	5.0 ± 0.4	5.5 ± 0.3	5.5 ± 0.4	5.5 ± 0.4

Experimental results (Table 3) confirm slow colour changes of tested emulsions during storage at ambient temperature. Darkening of liqueur's color (atypical colour, dark-brown colour) within whole volume was observed after 104 days of storage. Addition of tocopherol may be a significant protection against liqueur's darkening process. Its higher concentrations (0.05%) caused reduction of unfavourable changes of Advocaate's look by about 60 days, and addition of 0.1% of tocopherol influenced on relatively stable colour during all storage period. Saturation of liqueurs with nitrogen and increasing of their acidity (lactic or ascorbic acids) did not reduce the sample darkening.

Samples of liqueurs completed with selected additives were the continuation of above experiments. Also other components that increased the colloid stability of emulsions (sodium caseinate and lecithin) were introduced into Advocaates.

Very uniform level of colour intensity was observed in liqueurs just after their preparation under laboratory conditions (2.40°-2.42° NEPA) (Fig. 2). Gradual liqueur darkening and decomposition of egg components occurred in time, which contributed to the decrease of spectrophotometric results. The colour index for control samples changes by about 35% during 119 days. Advocaates with some additives (tocopherol + ascorbic acid, tocopherol + ascorbic acid + lecithin, and tocopherol + ascorbic acid + sodium caseinate) were characterized by a high stability of yellow components. The colour intensity decreased only by about 10% in above samples during storage.



*Samples set-up in industrial conditions.
K – control sample, KAZ – sodium caseinate, LEC – lecithin, TOK – tocopherol, ASK – ascorbic acid.
*Próby zestawione w warunkach przemysłowych.
K – próba kontrolna, KAZ – kazeinian sodu, LEC – lecytyna, TOK – tokoferol, ASK – kwas askorbinowy.

Fig. 2. The influence of storage time on colour intensity changes in creams supplemented with different stabilizing additives
Rys. 2. Zmiany intensywności zabarwienia podczas przechowywania kremów emulsyjnych uzupełnionych różnymi mieszaninami dodatków stabilizujących

Samples prepared under industrial conditions enriched with tocopherol and lecithin as well as sodium caseinate plus lecithin and tocopherol were distinguished by slower dye decomposition (1.75°-1.86° NEPA) in reference to control.

For comparison, also visual browning rate of stored liqueurs was performed (Table 4).

At the day of preparation, fresh Advocaate's colour was significantly different. All liqueurs enriched with ascorbic acid addition were darker as compared to other samples. Gradual liqueur's darkening occurred during storage (133 days). The process was relatively fast in a case of liqueur with ascorbic acid addition (about 10 cm^3 of methyl orange). Samples enriched with tocopherol, but without ascorbic acid, were relatively resistant to darkening. The liqueur's colour intensification occurred mainly during the first two months of the experiment.

Industrially prepared Advocaates, directly after preparation, were characterized by the same (5.5 cm^3 of methyl orange) colour index. Browning of control sample was slightly faster than in other liqueurs (Table 4). Emulsions completed with tocopherol along with lecithin relatively slowly changed their colour (8.2 cm^3 of methyl orange after 133 days of storage).

Table 4. Changes of colour intensity in emulsion samples during storage
Tabela 4. Zmiana intensywności zabarwienia badanych prób kremów w czasie przechowywania

Specification Wyszczególnienie	Storage period, days Czas przechowywania, dni				
	0	32	68	98	133
	colour, cm^3 – methyl orange, cm^3 barwa, cm^3 – oranż metylowy, cm^3				
Control sample Próba kontrolna	5.0 ± 0.3	7.0 ± 0.4	7.5 ± 0.4	8.0 ± 0.5	8.5 ± 0.4
Tocopherol/ascorbic acid Tokoferol/kwas askorbinowy	7.5 ± 0.5	8.5 ± 0.5	9.0 ± 0.4	9.5 ± 0.5	10.0 ± 0.5
Tocopherol/lecithin Tokoferol/lecytyna	5.0 ± 0.4	6.5 ± 0.3	7.0 ± 0.4	7.5 ± 0.4	7.8 ± 0.5
Tocopherol/sodium caseinate Tokoferol/kazeinian sodu	5.0 ± 0.3	6.5 ± 0.4	7.0 ± 0.5	7.5 ± 0.5	7.8 ± 0.4
Lecithin/ascorbic acid Lecytyna/kwas askorbinowy	7.5 ± 0.4	8.8 ± 0.4	9.5 ± 0.3	10.0 ± 0.6	10.3 ± 0.6
Ascorbic acid/sodium caseinate Kwas askorbinowy/kazeinian sodu	7.5 ± 0.3	8.8 ± 0.3	9.5 ± 0.4	10.0 ± 0.5	10.3 ± 0.5
Tocopherol/ascorbic acid/lecithin Tokoferol/kwas askorbinowy/lecytyna	7.5 ± 0.2	8.5 ± 0.4	9.0 ± 0.3	9.5 ± 0.4	10.0 ± 0.6
Tocopherol/ascorbic acid/sodium caseinate Tokoferol/kwas askorbinowy/kazeinian sodu	7.5 ± 0.5	8.5 ± 0.5	9.0 ± 0.5	9.5 ± 0.5	10.0 ± 0.4
Sodium caseinate/lecithin/tocopherol Kazeinian sodu/lecytyna/tokoferol	5.0 ± 0.2	6.5 ± 0.3	7.0 ± 0.4	7.5 ± 0.5	7.8 ± 0.5
Sodium caseinate/lecithin/ascorbic acid Kazeinian sodu/lecytyna/kwas askorbinowy	7.5 ± 0.3	8.8 ± 0.4	9.5 ± 0.5	10.0 ± 0.6	10.3 ± .06
Control sample* Próba kontrolna*	5.5 ± 0.4	7.0 ± 0.5	7.8 ± 0.4	8.5 ± 0.4	9.0 ± 0.3
Lecithin/tocopherol* Lecytyna/tokoferol*	5.5 ± 0.3	6.5 ± 0.4	7.0 ± 0.4	7.5 ± 0.4	8.2 ± 0.5
Lecithin/sodium caseinate/tocopherol* Lecytyna/kazeinian sodu/tokoferol*	5.5 ± 0.2	6.5 ± 0.4	7.0 ± 0.3	8.0 ± 0.5	8.5 ± 0.4

*Samples set-up in industrial conditions.
*Próby zestawione w warunkach przemysłowych.

Reactions of non-enzymatic browning may be the reason for darkening of egg emulsions. Thus, the dynamics of Maillard's compounds content change was made applying spectrophotometric technique (420 nm wavelength). The determination results are graphically presented on Figures 3 a and 3 b.

Absorbance at 420 nm is strictly correlated with Maillard's compound concentrations in tested liqueurs – the higher values, the higher share of analysed components. Fresh Advocaates, directly after preparation, were characterized by significantly different absorbances. Higher measurement results were achieved for all liqueurs with ascorbic acid addition (0.060-0.067). Storage of tested liqueurs caused the increase of absorbance (increase of Maillard's compound concentrations). Rate of the formation of components

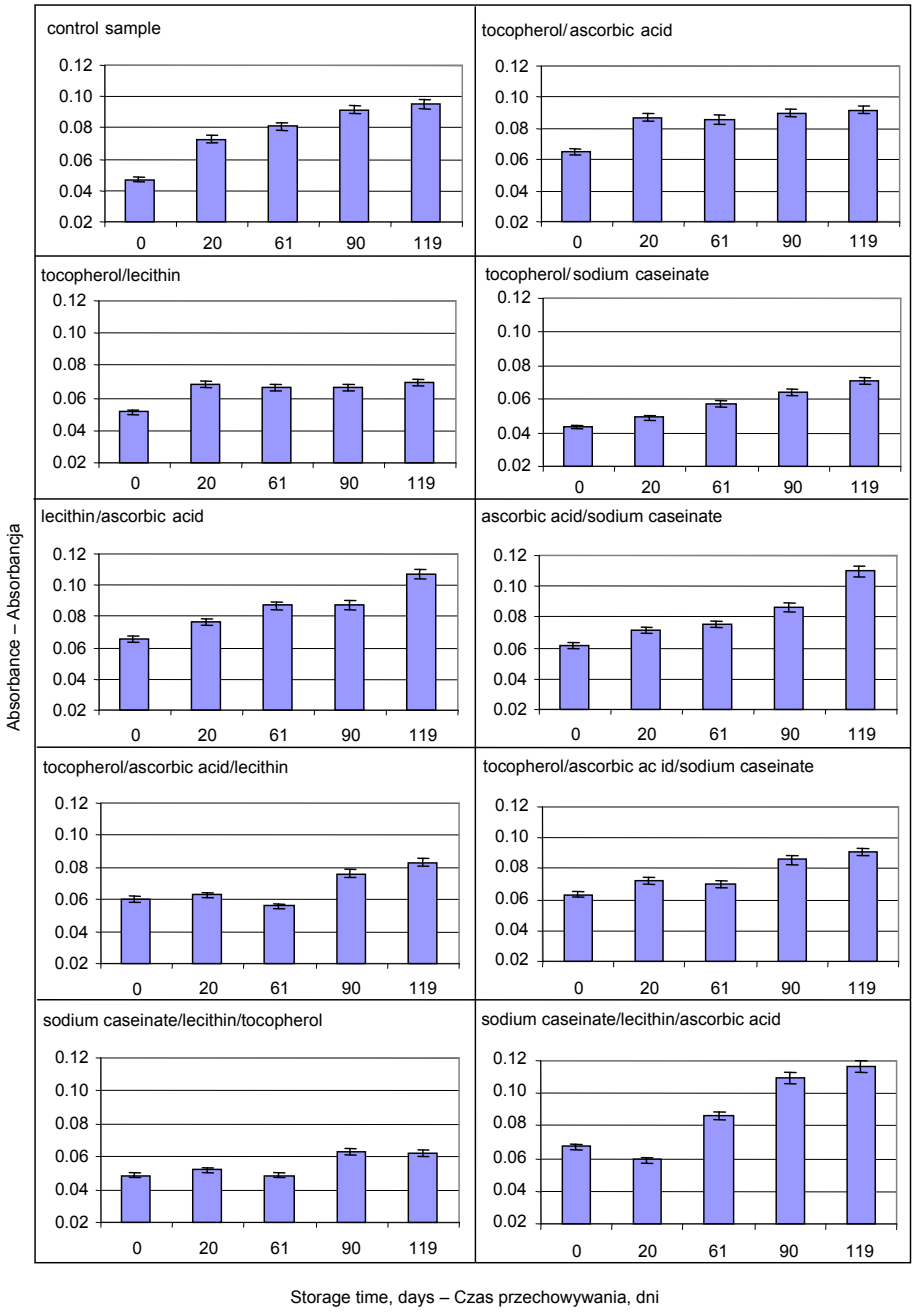


Fig. 3 a. Absorbance changes of tested emulsion creams during storage
Rys. 3 a. Zmiany absorbancji w badanych kremach podczas ich przechowywania

that give the brown colour to liqueurs depended on anti-oxidative additives applied. Advocaates enriched with ascorbic acid were characterized, after long-term storage, by higher absorbance (about 0.11) in reference to control samples (0.095). The increase of Maillard's compound concentration was much reduced in liqueurs with tocopherol addition, both in laboratory (Fig. 3 a) and industrial (Fig. 3 b) samples. The highest resistance to a typical darkening was found in liqueurs enriched with tocopherol plus lecithin as well as tocopherol with lecithin and sodium caseinate.

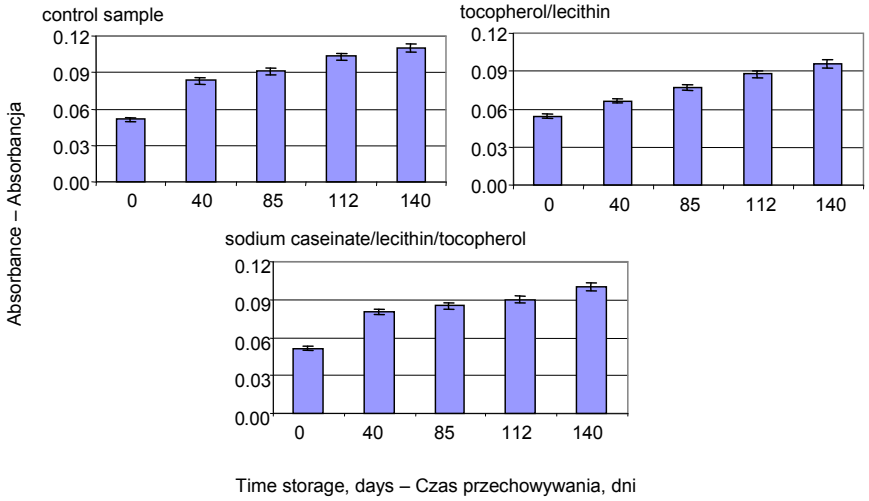
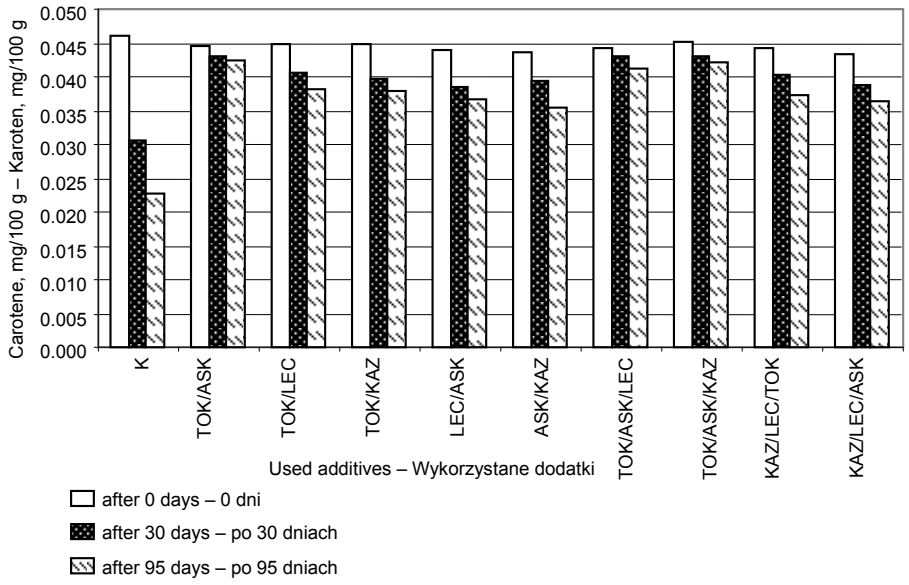


Fig. 3 b. Changes of absorbance in tested emulsion creams during storage – samples set--up in industrial conditions
Rys. 3 b. Zmiany absorbancji w czasie przechowywania kremów, uzupełnionych różnymi dodatkami stabilizującymi – próby przemysłowe

The quantitative analysis of carotenoids in samples prepared under laboratory conditions was performed by means of HPLC technique to confirm the rate of their decomposition. Determinations of carotenes expressed as β-carotene were made in fresh liqueurs as well as after one and three months of storage (temperature 20°-24°C, daily light). Achieved results are presented on Figure 4.

Carotenes concentration in fresh liqueurs was very uniform (about 0.044 mg/100 g). The sample storage contributed to partial dye decomposition. Significantly lower contents of determined components (after 90 days of observation) were found in control samples and with lecithin and sodium caseinate (about 0.02 mg/100 g). Liqueurs enriched with tocopherol and ascorbic acid were characterized, after storage, by slightly less content of carotenes (Fig. 4).



K – control sample, KAZ – sodium caseinate, LEC – lecithin, TOK – tocopherol, ASK – ascorbic acid
K – kontrola, KAZ – kazeinian sodu, LEC – lecytyna, TOK – tokoferol, ASK – kwas askorbinowy

Fig. 4. Changes of carotene content in tested emulsion creams during storage
Rys. 4. Zmiany zawartości karotenów w kremach emulsyjnych podczas ich przechowywania

Finding the colour standard for egg liqueur

Chemical standards of liqueur's colour were prepared using sodium soap emulsified with edible oil and various concentrations of methyl orange, and then analysis of consumer's preference was performed (Table 5).

Table 5. Tests of consumer preference
Tabela 5. Test preferencji konsumenckich

Emulsion composition cm^3 methyl orange on 100 cm^3 solution Skład emulsji ilość cm^3 oranżu metylowego na 100 cm^3 roztworu	Colour intensity NEPA degree Intensywność zabarwienia stopnie NEPA	Consumer preference, % Preferencje konsumenckie, %
2.0	1.59	0.0
3.0	2.52	53.8
3.5	5.82	30.8
4.0	5.95	7.8
4.5	10.99	3.8
5.0	11.68	3.8
5.5	16.31	0.0
6.0	25.39	0.0

On a base of presented test's results, it can be found that emulsion model to which 3 cm^3 of methyl orange per 100 cm^3 of solution (0.01%) was added, was considered as preferred (over 50% of respondents) in reference to its color. The most required Advocaate should be characterized by medium intensive golden-yellow colour described as 2.5° NEPA grade. Liqueurs with light yellow and intensively orange colour were completely disqualified by testing team (Table 5).

DISCUSSION

Advocaate-type liqueurs have specific sensoric virtues and they are the most popular alcoholic beverages among all liqueurs. They contain hen's egg yolks that are fat sources and make the final products typical yellow colour. The yolk's colour is the most important criterion at its qualitative evaluation and it depends on the amount and concentration of carotenoids in eggs. Due to physical, chemical and chemical transformations, the change of sensoric traits of a final product, namely colour, takes place, which in general leads to its quality worsening.

The aim of experiments was to test the colour stability of egg liqueurs enriched with anti-oxidative agents during storage. Substances showing potentially anti-oxidative properties should reduce the liqueur's colour change. Agents utilized in the experiments are strong oxygen-trapping and free-radical-sweeping compounds [Zhang and Omaye 2000, Beddows et al. 2001, Moure et al. 2001]. Furthermore, it was found [Jajczarstwo... 2000] that slight pH decrease should inhibit the browning processes of yolk matter. Lactic acid was applied in experiments as a factor that influences the liqueur's reaction. Slight acidity increase also took place due to ascorbic acid. Moreover, modifications of technological process such as saturation with neutral gas (nitrogen) and storage with no daily light access were applied.

Spectrophotometric determinations revealed that applied modification of Advocaate's composition had their significant influence on decomposition of carotenoids responsible for the final product's colour. However, all samples got brown and antioxidant addition only slightly inhibited the process. Relative resistance to darkening characterized liqueurs with tocopherol addition (0.05 and 0.1 %). It is worth underlining that achieved results do not confirm earlier studies [Anduła 1996], in which the improvement of liqueur colour stability was obtained using 0.001% ascorbic acid solution. There is lack more detailed information on colour stability of alcoholic egg emulsions and method for their evaluation in available literature. Many publications refer to the specificity of egg's yolk colour estimation [Weber and Berry 1977, Fletcher 1980]. Other experiments mainly focused on the anti-oxidative role of various compounds in reference to lipid oxidation [Frankel 1996, Chen et al. 1998, Beddows et al. 2001, Zhang and Omaye 2000]. The aspect of dye protection in alcoholic egg emulsions due to anti-oxidative substances was not undertaken.

As a result of spectrophotometric measurements of liqueurs with stabilizing mixtures addition (Fig. 2), it was found that tocopherol inhibited the dye decomposition in tested liqueurs. Carotenes concentration during the experiment also decreased and its rate depended mainly on agents applied. Samples enriched with tocopherol along with ascorbic acid were characterized by much slower decomposition of studied compounds. It was proved that tocopherol is an important factor that makes carotene oxidation reac-

tion slower. Addition of ascorbic acid into a liqueur also inhibited degradation of determined dyes, but to a much lesser extent as compared to emulsions enriched with tocopherol. However, spectrophotometric analysis results did not confirm significant changes of Advocaate's color (Table 4). It was found that tocopherol contributed to the reduction of liqueur darkening during storage, but observed differences (in reference to control) were small. Samples containing ascorbic acid faster got brown (just at the first 24 hours after preparation). Such phenomenon was not observed in earlier experiments where five times lower ascorbic acid concentration were used.

Achieved results allow for rejecting the thesis that the decomposition of native dyes, mainly carotenoids, is a primary reason for liqueur's darkening. Also compounds formed during storage may influence the liqueur's colour. The most intensive formation of Maillard's compounds was found in bakery products during their thermal processing [Manzocco et al. 2001]. However, carbonyl-protein reactions take place at ambient temperature as well. Lertsiri et al. [1998] recorded formation of Amadori's compounds just after four days of phosphatydyloethyloamine from egg's yolk with glucose at 37°C. Measurements of Maillard's compounds contents in tested liqueurs by means of spectrophotometric technique (Fig. 3) revealed gradual increase of their share during Advocaate's storage. It is worth mentioning that samples with ascorbic acid addition were characterized by higher (by about 20%) initial concentration of Maillard's compounds as compared to other liqueurs. It was probably due to pH decrease resulting from the ascorbic acid introduction. Similar acceleration of non-enzymatic browning was recorded in research by Martins et al. [2001].

To verify the laboratory tests results, Advocaates were prepared under industrial conditions (Improved Vodka Manufacture). Samples were enriched with stabilizers (tocopherol, lecithin and sodium caseinate) in various combinations and changes occurring during storage were observed.

Analyses results referring to colour of alcoholic liqueurs prepared using pressure homogenizer did not significantly differ from laboratory samples. A slight influence of tocopherol on browning delay at tested liqueurs was found. On a base of absorbance measurements (λ = 420 nm) of liqueurs prepared under industrial conditions, the efficiency of tocopherol as a component reducing the Maillard's compounds formation, was confirmed. However, applied modifications (stabilizers addition) did not ensure complete stability of Advocaate's colour during storage.

Enrichment of egg yolks with anti-oxidants (mainly tocopherol) through proper laying hen's feeding and studies associated with replacement of some carotenoid dyes with other ones that would be more stable and permissible for foodstuff production, should be a suggested continuation of above experiments.

Experiments associated with finding the colour standard for Advocaate-type alcoholic egg liqueur revealed that sample prepared using 5 g of sodium soap emulsified with 1 cm^3 of sunflower oil and completed with 50 cm^3 of distilled water and 3 cm^3 of 0.1% methyl orange might be considered as the most required standard.

Visual estimation of tested samples colour using experimentally selected standard mixture confirmed the usefulness of comparative method, particularly for finding the liqueur's colour desired by consumers. However, it should be emphasized that applied methods for egg emulsion's colour evaluation take into account exclusively the colour intensity. Other changes described as atypical may be presented only in descriptive manner.

CONCLUSIONS

1. The rate of carotenoid decomposition is not a general reason for Advocaate's darkening during storage. Browning of liqueurs is associated, among others, with Maillard's reactions during preparation and storage.

2. Completing the liqueurs with anti-oxidants (particularly 0.1% tocopherol) significantly reduces yellow-orange dyes (mainly carotenoids) decomposition during storage, but it does not completely inhibit the negative change of their colour (browning).

3. Sample prepared from 5 g of sodium soap emulsified with 1 cm^3 of plant oil completed with 50 cm^3 of distilled water and 3 cm^3 of methyl orange (0.1%) may be considered as relatively useful and stable standard of liqueur colour.

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WPŁYW WYBRANYCH DODATKÓW NA TRWAŁOŚĆ BARWY ALKOHOLOWYCH KREMÓW EMULSYJNYCH

Streszczenie. Wprowadzanie do kremów składników przeciwutleniających (szczególnie tokoferolu w ilości 0,1%) przyczynia się do ograniczenia rozkładu związków odpowiedzialnych za barwę wyrobu (głównie karotenoidów), oznaczanych metodami spektrofotometrycznymi. Zastosowana modyfikacja nie spowalnia jednak całkowicie brunatnienia Advocaatów (wizualna ocena barwy) w czasie przechowywania. Za negatywną zmianę barwy kremów odpowiedzialne są raczej składniki powstające podczas nieenzymatycznego brunatnienia w wyniku reakcji Maillarda. Odpowiedni wzorzec barwy kremów jajowych może stanowić emulsja przygotowana z mydła sodowego, oleju roślinnego i wody destylowanej oraz oranżu metylowego.

Słowa kluczowe: krem emulsyjny, stabilność barwy, dodatki do żywności

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