THE EFFECT OF ANTHOCYANIN BASED EXTRACTS ON THE COLOR OF CEMEN PASTE USED ON PASTIRMA, A DRY CURED MEAT PRODUCT

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***Abstract*-Color is an important quality parameter of a food and major factor affecting sensory perception and consumer acceptance of the foods. Food colorants, natural and synthetic, have been commonly added to the foods in order to compensate the loss of natural colors that destroyed during the processing and storage. Cemen is the covering part of pastirma, an esteemed meat product in Middle East. It has a protective effect against mould growth and oxygen penetration on and through the surface of the product that has been colored with synthetic food dyes or carmine conventionally. Not to mention synthetic dyes, carmine, an extract of cochineal insect, is generally regarded as safe but some consumers try to avoid from this dye due to personal preference, moral convictions or allergic reactions following the ingestion. The objective of this study was to investigate the anthocyanin based plant extracts as color stabilizer in the cemen paste to have positive perception on consumers. The cemen paste was divided to 5 homogenous groups; the first group was added 200 ppm carmine, the second, third and fourth groups were added 20 ppm black carrot (*Daucus carota*), red cabbage (*Brassica oleracea* L. var. *capitata f. rubra*) and black grape (*Vitis vinifera*) skin extracts, with a control group containing no dye, and they were stored for 21 days at 4ºC. The results showed that the storage time and type of extracts had an effect ($p<0.01$) on lightness (*L**), redness (*a**), yellowness (*b**), hue angle (*h*°) and chroma (*C**) values of the cemen pastes stored at 4ºC for 21 days. In conclusion, anthocyanin based extracts of black carrot and red cabbage could be used as color stabilizer in the cemen paste instead of carmine a certain period of time.**

Key Words: Anthocyanin, carmine, cemen paste, color, pastirma

I. INTRODUCTION

Pastirma is one of the salted and partially fermented dry cured meat products that is pasted with cemen (outside covered with a paste that makes it different from its counterparts) and stored for several months without refrigeration, and it is highly regarded and popular in most of the Middle East countries (Yetim, Sagdic, Dogan & Ockerman, 2006). Cemen is made up with ground fenugreek seeds, crushed garlic and chilli pepper that mixed to a paste with enough water (Altuntaş, Özgöz & Taşer, 2005). It is pasted on the surface of the cured meat, approximately 3-5 mm thick (Yetim, Sagdic, Dogan & Ockerman, 2006; Kaban, 2009). Cemen has a protective effect against mould growth and oxygen penetration, on and through the surface of the pastirma. High nutritional values and typical flavor from the cemen have led to an increase in pastirma consumption (Aksu, Kaya & Ockerman, 2005). In general, color plays a very important role in the acceptability of foods. Consumers first judge the quality of a food product by its color, and the food industry has used colorants for centuries to enhance or restore original appearance of the foods and to ensure uniformity, as indicator of food quality (Giusti & Wrolstad, 2003). The surface of the pastirma is covered with cemen that has conventionally been colored with synthetic or natural food dyes, e.g. carmine. Leaving the synthetic dyes aside, even some natural dyes have also been controversial. For example carmine, a naturally derived red dye, extracted from cochineal insect *Coccus cacti* has been used as coloring agent in some beverages, foods, medicines and cosmetics for years. It is generally regarded as safe, but some consumers do not desire the food prepared with carmine due to personal preference, moral/social convictions and reported some allergic reactions following the ingestion. In general, the low levels of carmine in foods and beverages limit oral exposure to this colorant. Thus, the likelihood of sensitization to carmine by ingestion is rather low. The most probable mechanism involved in adverse reactions to carmine is an IgE-mediated allergy. The sensitization would occur to protein residues present in carmine, and the carmine-specific IgE antibodies would be directed against one or more of those specific carmine-associated proteins (Lucas, Hallagan & Taylor, 2001). There are some reports that carmine caused severe hypertension or hypotension and bradycardia without change in blood pressure in a patient during general anesthesia (Kohno, Kitamura, Yamada, Sugihara & Ohta, 2005). Anthocyanins provide colors ranging from pink to violet in a variety of plant sources. The interests in and the motives for extended use of these colorants are influenced by their potential beneficial health effect (Torskangerpoll & Andersen, 2005). Health benefits associated with the anthocyanin extracts include enhancement of sight acuteness, antioxidant capacity, treatment of various blood circulation disorders resulting from capillary fragility, vaso-protective and anti-inflammatory properties, inhibition of platelet aggregation, maintenance of normal vascular permeability, controlling diabetes, anti-neoplastic and chemoprotective agents, radiation-protective agents, and possibly some others due to their diverse action on various enzymes and metabolic processes (Giusti & Wrolstad, 2003). In this study, the effects of anthocyanin based extracts of black carrot (*Daucus carota*), black grape (*Vitis vinifera*) skin and red cabbage (*Brassica oleracea* L. var. *capitata f. rubra*) on cemen paste color were evaluated as an alternative color stabilizer in cemen paste, carmine which might be undesirable due to the beliefs or negative health effects.

II. MATERIALS AND METHODS

A. Plant materials

Basic cemen ingredients; fenugreek (*Trigonella foenumgraecum* L.), garlic (*Allium sativum* L.), red pepper (*Capsicum annuum*) powder and salt were purchased from local markets in Kayseri, Turkey. Black carrot (*Daucus carota* L.) and red cabbage (*Brassica oleracea* L. var. *capitata f. rubra*) were suplied by Konya Eregli and Yemliha-Kayseri Turkey, respectively and transferred to Erciyes University in plastic bags which contains holes for respiration and kept at -86°C until the extraction. Black grape (*Vitis vinifera*) pomace samples were kindly donated by Doluca Winery Tekirdag-Turkey. Seed, stem and skin fractions of the pomace sample was separated manually, and the skin fraction was dried at 65°C for 24 h and ground with a laboratory type grinder to use anthocyanin extraction.

B. Preparation of anthocyanin extracts

After thawing the plants at 4°C for 12 h, 50 g of material was ground in a Waring blender with 150 ml of 96% ethanol:water (1:1) solution acidified with 0.1% hydrochloric acid. The blended plant slurries were macerated for 2 min to extract anthocyanins. The samples were transferred to 500 ml jars and, the blender was washed with extra 50 ml extraction solvent to recollect the residue. Anthocyanins were extracted at 35°C water bath for 2 h while stirring continuously. Solid part of the slurry was separated by using a filter paper, and then the filtered extract was passed through Whatman No. 1 filter paper by using Buchner funnel under vacuum conditions. The extraction solvent was evaporated at 60°C under the vacuum. Then the dried extracts were transferred to tubes and oxygen was removed by using nitrogen and kept at -86°C until the use. The extracts were dissolved in distilled water, and their brix were adjusted to 60° and these samples were used as color stabilizer in the cemen paste.

C. Preparation of cemen paste

Experimental cemen was made from fenugreek, garlic, red pepper powder, salt and water. 28.1% of ground fenugreek, 20.4% of crushed garlic, 8.7% of powdered red pepper, 1% salt and 41.8 % of potable tap water were homogenously mixed till a spreadable consistency. The cemen paste was divided to 5 homogenous groups; the first group was added 200 ppm carmine, the second, third and fourth groups were added 20 ppm black carrot, red cabbage and black grape skin extracts, control group had no dye at all, and they were packed under vacuum or not and stored at 4°C for 0,1, 3, 5, 7, 14 and 21 days.

D. Color

Color measurements of the cemen pastes were performed using a chromameter (Lovibond RT Series Reflectance Tintometer, U.K.). The measurements were carried out nine times, and the L^*, a^* and b^* color parameters were recorded as L^* (lightness), a^* (redness) and b^* (yellowness). The hue angle [$h°$= arctan (b*/a*)] and chroma values [$C^* = (a^{*2} + b^{*2})^{1/2}$] were also calculated (Pazmino-Duran, Giusti, Wrostald & Gloria, 2001).

E. Statistical analyses

SAS statistical software (SAS, 1988) was used for the data analysis. The data were subjected to analysis of variance (ANOVA), and comparative analyses between the means were conducted using Tukey test. Differences were considered significant if $p \leq 0.01$.

III. RESULTS AND DISCUSSION

In this study, the effects of anthocyanin based extracts of black carrot, black grape skin and red cabbage on cemen paste color were evaluated. The cemen pastes samples colored with three different anthocyanin based extract and carmine were compared with the control samples (without added colorant) were shown in Table 1. The total anthocyanin contents of the 60° brix black carrot, red cabbage and black grape skin extract samples were 1986.54, 4732.31 and 6259.75 mg monomeric anthocyanin/kg extract respectively. The 20 ppm anthocyanin extracts were added to cemen paste (2 mg monomeric anthocyanin/100 g cemen paste).

The effect of packaging type (data not shown) has no significant effect on L^*, a^*, b^*, hue and chroma values ($p<0.01$). Because of this reason, in this paper we decided to give results of the cemen packaged without vacuum which is a general commercial type of cemen packaging. Storage time and coloring materials had an effect on lightness (L^*), redness (a^*) and yellowness (b^*), hue angle ($h°$) and chroma (C^*) values of cemen pastes stored at 4ºC ($p<0.01$). $L*$ values of the control samples (without colorant) were higher than that of the other samples which had added coloring agents. In general, addition of natural colorants decreased $L*$ values (Kammerer, Schillmöller, Maier, Schieber & Carle, 2007). The a^* values (redness) of the samples which had carmine were higher than that of the other samples. Despite some fluctuations in $b*$ values and especially in $a*$ values, a general decline towards the end of the storage was observed. Accordingly, chroma (C^*) values reflecting the color brilliance exhibited the same trends, and it started to decline after seventh of storage days. It was reported that C^* values of products is correlated with the degree of anthocyanin acylation (Kammerer, Schillmöller, Maier, Schieber & Carle, 2007). However, color tone of ($h◦$) the cemen pastes were slightly increased during storage.

Table 1. *L**, *a**, *b**, hue angle *h*◦ and chroma *C** values of cemen pastes prepared with black carrot, red cabbage and red grape skin extracts and carmine during the 21 days of storage,

	Storage time[1]	Control	Carmine	Red cabbage	Black carrot	Black grape skin
	0	40.08 ^{aA} ±0.36	38.14^{aA}±1.43	35.60^{aA}±0.03	35.30^{aA}±1.73	32.63^{aA}±0.10
	1	39.40 ^{aA} ±0.06	35.74^{bB}±0.80	35.33^{abB}±0.24	35.16 ^{aB} ±0.56	32.99^{aB}±0.93
	3	39.39 ^{aA} ±0.08	37.30^{abA}±0.52	35.71^{aAB}±0.63	35.03 ^{aAB} ±1.32	31.48^{abB}±0.96
*L**	5	39.07^{aA}±0.65	37.65^{abA}±0.49	35.16^{abB}±0.31	34.54 ^{aB} ±0.25	30.40^{abcC}±0.06
	7	34.19^{bA}±0.01	31.12^{cA}±0.64	34.01^{abcA}±2.04	32.55 ^{aA} ±2.61	27.03^{cdA}±1.00
	14	31.08^{cA}±0.44	29.76^{cAB}±0.65	30.48^{cA}±0.05	29.21 ^{aAB} ±2.09	25.92^{dB}±0.29
	21	30.74^{cA}±0.36	30.59^{cA}±0.66	30.85^{bcA}±0.21	29.20 ^{aA} ±0.47	27.92^{bcdA}±0.96
	0	16.85^{bcAB}±1.05	18.80^{bcA}±0.76	15.21^{cAB}±0.31	14.21^{bAB}±1.29	11.83^{bB}±0.41
	1	24.09^{aA}±0.05	25.19^{aA}±1.52	23.32^{aA}±0.70	21.90^{aA}±0.50	16.80^{abB}±0.00
	3	21.26^{abB}±1.18	25.53^{aA}±0.15	18.68^{aB}±0.03	19.16^{abB}±0.65	18.86^{aB}±0.92
*a**	5	23.25^{aA}±1.21	20.91^{bA}±0.07	18.37^{aA}±0.01	18.84^{abA}±0.11	18.11^{abA}±2.47
	7	21.15^{abAB}±0.43	22.23^{abA}±0.42	15.00^{cB}±0.16	16.56^{abAB}±2.54	15.75^{abAB}±0.48
	14	17.90^{bcAB}±0.99	18.44^{bcA}±0.51	14.35^{cC}±0.11	15.15^{bBC}±0.27	13.82^{abC}±0.43
	21	15.66^{cAB}±0.76	16.61^{cA}±0.39	13.77^{cBC}±0.26	14.27^{bABC}±0.15	12.68^{bC}±0.40
	0	41.34^{aA}±1.34	39.68^{aA}±1.88	37.49^{aAB}±1.02	34.62^{abAB}±1.52	30.34^{aB}±1.88
	1	41.70^{aA}±0.29	39.51^{aA}±2.11	38.30^{aA}±1.64	38.36^{aA}±0.76	29.36^{abB}±0.03
	3	39.33^{abA}±2.44	38.67^{abA}±0.84	33.45^{abA}±0.15	32.88^{abcA}±2.21	31.12^{aA}±0.06
*b**	5	39.75^{abA}±1.54	33.76^{abA}±2.28	32.67^{bA}±1.09	30.93^{abcA}±0.04	30.40^{aA}±2.00
	7	32.98^{bcA}±0.74	31.96^{abcAB}±0.31	21.93^{cB}±0.31	24.29^{cAB}±3.69	22.13^{bcB}±1.83
	14	29.66^{cdA}±0.84	28.00^{bcA}±3.72	21.52^{cA}±0.54	29.46^{abcA}±1.56	20.24^{cA}±0.35
	21	24.41^{dA}±0.06	22.46^{cAB}±0.55	22.09^{cAB}±0.50	24.82^{bcA}±1.40	19.52^{cB}±0.02
	0	67.87^{aA}±0.60	64.62^{aA}±0.17	67.95^{aA}±0.14	67.75^{aA}±0.93	68.69^{aA}±0.56
	1	60.01^{bA}±0.13	57.52^{abC}±0.19	58.68^{bcB}±0.33	60.31^{bcA}±0.07	60.25^{abA}±0.03
	3	61.62^{bA}±0.16	56.58^{bB}±0.72	60.85^{bAB}±0.07	59.74^{bcAB}±0.84	58.82^{abAB}±1.29
h◦	5	59.67^{bA}±2.26	58.14^{abA}±1.68	60.65^{bA}±0.82	59.51^{bcA}±0.93	59.39^{abA}±1.78
	7	57.35^{bA}±0.05	55.21^{bA}±0.77	55.65^{cA}±0.66	55.74^{cA}±0.04	54.45^{bA}±3.06
	14	58.94^{bA}±0.68	56.39^{bA}±2.81	56.32^{cA}±0.86	62.79^{bA}±0.58	55.71^{bA}±0.37
	21	57.37^{bAB}±1.20	53.55^{bB}±0.04	57.98^{bcAB}±1.13	60.11^{bcA}±1.17	57.03^{abAB}±0.79
	0	44.65^{abA}±1.64	43.92^{abA}±2.02	40.46^{abAB}±1.06	37.43^{abAB}±1.90	32.57^{abcB}±1.89
	1	48.15^{aA}±0.28	46.86^{aA}±2.59	44.84^{aA}±1.76	44.17^{aA}±0.91	33.83^{abB}±0.02
	3	44.71^{abAB}±2.71	46.34^{aA}±0.62	38.31^{bAB}±0.14	38.06^{abAB}±2.24	36.40^{aB}±0.43
*C**	5	46.09^{abA}±0.72	39.73^{abAB}±1.97	37.49^{bAB}±0.94	37.16^{abAB}±0.85	35.40^{aB}±2.98
	7	39.18^{bcA}±0.86	38.94^{abcAB}±0.01	26.57^{cC}±0.17	29.40^{bABC}±4.48	27.21^{bcdBC}±1.21
	14	34.65^{cdA}±1.23	33.57^{bcAB}±3.39	25.87^{cAB}±0.39	33.13^{abAB}±1.07	24.51^{cdB}±0.53
	21	29.01^{dA}±0.46	27.94^{cA}±0.68	26.05^{cAB}±0.27	28.63^{bA}±0.80	23.28^{dB}±0.24

[1:] Days, ^{AB} Means with different capital letters in the same row compare the coloring agents and show significant differences at $p<0.01$, ^{ab} Means with lowercase on the same column compare the storage times and show significant differences at $p<0.01$.

IV. CONCLUSION

The color properties of cemen pastes were influenced by the source of anthocyanin and storage time. The results showed that anthocyanin based extracts of black carrot and red cabbage could be used as color stabilizer agent in cemen acertain period of time, at least seven days of storage. The red grape skin extract seems to be not a suitable coloring agent in cemen paste, due to a slight brown colour.

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REFERENCES

Alasalvar, C., Al-Farsi, M., Quantick, P. C., Shahidi, F., & Wiktorowicz, R. (2005). Effect of chill storage and modified atmosphere packaging (MAP) on antioxidant activity, anthocyanins, carotenoids, phenolics and sensory quality of ready-to-eat shredded orange and purple carrots. *Food Chemistry*, 89 (1), 69–76.

Aksu, M. I., Kaya, M., & Ockerman, H.W. (2005). Effect of modified atmosphere packaging, storage period, and storage temperature on the residual nitrate of sliced-pastirma, dry meat product, produced from fresh meat and frozen/thawed meat. *Food Chemistry*, 93, 237–242.

Altuntaş, E., Özgöz, E., & Taşer, Ö.F. (2005). Some physical properties of fenugreek (*Trigonella foenum-graceum* L.) seeds. *Journal of Food Engineering*, 71, 37–43.

Giusti, M. M., & Wrolstad, R. E. (2001). Unit F1.2. Anthocyanins. Characterization and measurement with UV–visible spectroscopy. In R. E. Wrolstad & S. J. Schwartz (Eds.), Current protocols in food analytical chemistry. New York: Wiley.

Giusti, M.M., & Wrolstad, R. E. (2003). Acylated anthocyanins from edible sources and their applications in food systems. *Biochemical Engineering Journal*, 14, 217–225.

Kaban, G. (2009). Changes in the composition of volatile compounds and in microbiological and physicochemical parameters during pastirma processing. *Meat Science*, 82, 17–23.

Kammerer, D.R., Schillmöller, S., Maier, O., Schieber, A., & Carle, R. (2007). Colour stability of canned strawberries using black carrot and elderberry juice concentrates as natural colourants. *European Food Research and Technology*, 224, 667–679.

Kohno, Y., Kitamura, S., Yamada, T., Sugihara, K. & Ohta S. (2005). Production of superoxide radical in reductive metabolism of a synthetic food-coloring agent, indigocarmine, and related compounds. *Life Sciences*, 77(6), 601-614.

Lucas, C.D., Hallagan, J.B. & Taylor, S.L. (2001). The role of natural color addıtives in food allergy. *Advances in Food and Nutrition Research*, 43, 195-215.

Pazmino-Duran, E.A., Giusti, M.M., Wrostald, R.E., & Gloria, B.A. (2001). Anthocyanins from banana bracts (*Musa X paradisiaca*) as potential food colorants. *Food Chemistry*, 73; 327-332.

SAS, 1988. SAS/STAT User's Guide (6.03); SAS Institute, Inc.: Cary, New York.

Torskangerpoll, K., & Andersen, Ø. M. (2005). Colour stability of anthocyanins in aqueous solutions at various pH values. *Food Chemistry*, 89, 427–440.

Yetim, H., Sagdic, O., Dogan, M., & Ockerman, H.W. (2006). Sensitivity of three pathogenic bacteria to Turkish cemen paste and its ingredients. *Meat Science*, 74, 354–358.