57th ICoMST – Colour Parameters Evolution During Cooking in a Date Palm Concentrate Pâté

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Abstract— **OBJECTIVES: The aim of this study was to evaluate, by means of colour parameters, the influence of date palm concentrate upon colour during thermal processing of pork liver pâté.**

MATERIALS AND METHODS: Different ingredients combinations (pork liver pâté: liver, dewlap, curing agents and egg) and fresh date palm concentrate (5%) were processed and were analysed at different temperatures (20, 40, 60 and 80ºC). Color was measured using a spectrophotometer Minolta CM-2600. CIELAB colour space (D_{65} and 10º standard observer) and American Meat Science Association colour guidelines were used. Also reflectance (360-740 nm) spectra was analysed.

RESULTS: The addition of a 5% of date palm concentrate paste did not affect significantly the evolution and values of L*a*b* and C*, only hº showed differences at 40 and 60ºC, but at 80ºC, the final temperature that the product have to reach, no significant differences were found. Regarding to the reflectance spectra, both the pâté with and without date paste showed very similar spectra, particularly at 80ºC.

CONCLUSIONS: The addition of 5% paste from dates palm in pork liver pâté did not affect the reflectance spectra and colour properties significantly. Therefore, the date paste did not modify colour properties and can be integrated in the product correctly. Thereby, fresh dates at 5% could be used as an ingredient in cooked meat products, such as pâté.

Keywords— **Colour, pâté, date palm by-products.**

I. INTRODUCTION

Colour is very important for the food industry, since consumers' decision when purchasing is highly influenced by colour acceptability. Additionally, meat and meat products appearance is highly affected by colour. Therefore, consumers use colour as an indicator of quality, composition and freshness [1]. Thus, colour analysis should be considered in new products development. Objective equipments, such as colorimeters or spectrophotometers permit to obtain different information about food optical properties [2]. For instance, knowing the modifications of the optical properties of a product it is essential to assess the effect of the addition of novel ingredients [3].

A spectrophotocolorimeter, as was used in this work, besides to determine the CIELAB values (L*: lightness; a*: redness/greenness; b*: yellowness/ blueness), allows to measure the spectral response of a product to the visible radiation (400-700 nm), what is the light reflected by the surface of the sample. Thus, reflectance spectrum is an excellent tool to describe the meat and meat products colour appearance on surface, since each compound has a particular spectrum. Moreover, reflectance measurement is closely related to the visual perception [4].

In this case, the novel added ingredient to a pork liver pâté model system was a date palm paste from by-products from the date palm industry. Thereby, this study emerged as a consequence of the results of a previous work [5], in which pâtés with different date palm content were very accepted for consumers and their addition improved some of the product parameters. However, colour was the most affected parameter. Therefore, for this work the best concentration of date added to the pâté (5%) was selected to analyse influence on colour and its evolution during thermal processing, to evaluate its interaction with the other ingredients and to assess the most affected parameter when this paste was added.

II. MATERIALS AND METHODS

The most relevant ingredients for colour parameters of pork liver pâté (liver, dewlap, egg and curing agents) were combined with date paste from scalded (100°C for 3 min) date palm by-products (Confitera variety, khalal stage, from Elche, Spain). Traditional formula of pâtés include, among the selected ingredients for this assay: 75% dewlap, 25% pork liver; and the rest of ingredients related to meat content: 1.8% salt, 8% egg, 0.05% sodium ascorbate and 125 mg sodium nitrite/kg). Thus, resulted 6 different batches, all including the curing agents: EDP (egg + date paste 5%), DL (dewlap + liver), LDP (liver + date paste 5%), DDP (dewlap + date paste %), control (liver + dewlap + egg) and control + 5% DP (control + date paste 5%).

The ingredients received the same treatment than for pâté elaboration: the scalded dewlap and the soaked liver were blended in a mixer (MR 530, Braun), and the ingredients were added. The mixture was stuffed with a piping bag in a casing placed in a glass tube. Tubes were heated in a 90 ºC bath, and once the thermal centre reached 20, 40, 60 and 80 ºC, samples were immersed in ice to room temperature. When the temperature of the samples was stable, they were used to determine the CIELAB colour parameters (L*: lightness; a*: redness/greenness; b*: yellowness/blueness; C*: Chroma = $(a^2+b^2)^{0.5}$; hº: hue = arctang b/a) and the spectra of the light reflected by the surface each 10 nm between 360 and 740 nm. Recommendations of the AMSA [4] were followed and a Minolta CM-2600 spectrophotometer with illuminant D_{65} and 10° standard observer was used.

Statistical analyses were carried out using the statistical package SPSS 19.0 (Inc., Chicago, IL). Data was analysed with an ANOVA with two factors: temperature and treatments. The Tukey post hoc test ($P<0.05$) was used for comparison of means.

III. RESULTS

The statistical analyses showed significant differences (SD) ($P<0.05$) for all colour parameters (Table 1), among nearly all batches and temperatures. L* followed a clear tendency, at 40 ºC all batches decreased significantly ($P<0.05$), although been stable for the LDP batch. From 40 ºC until 80 ºC its tendency was to increase, except for the DDP, which tended to decrease ($P<0.05$). No SD ($P>0.05$) were found for L* between the control and the pâté with date. The a* values showed a more diverse trend, existed SD among all batches and some of the studied temperatures. While the EDP decreased when temperature increased, the LDP maintained a more stable pattern, and the other batches increased. DL and pâté with date presented a similar behaviour, with a higher increase from 60 to 80 ºC, although DL ≈ 4 units upper ($P<0.05$). SD ($P<0.05$) were found among the control and the pâté with date for the four temperatures, but at 80 ºC, the difference cannot be visually detected. LDP showed the highest a* values. The global tendency of the b* values was to decrease when temperature decreased, especially for the EDP. It is important to highlight that the control, the pâté with date and DL showed nearly the same values during the temperatures under study ($P>0.05$). LDP and DDP almost did not changed ($P>0.05$) during thermal treatment. C* and b* followed a similar behaviour, only could be detected a greater similarity between the pâté with date and the DL. Hue tended to decrease during heating, except for the EDP. DL and pâté with date again showed a parallel evolution during the thermal treatment, although showing SD ($P<0.05$). However, at 80 ºC the values of the control, pâté with date and DL were very close.

Regarding to the reflectance spectra (Fig. 1), an increment in the temperature revealed higher differences among all batches. Percentage of reflectance of the six batches was more proximate for 80ºC, and more similarity appeared among the main picks. The batches containing liver (LDP, DL, control and pâté with date) showed the more related spectra, being characteristic a maximum from the 650 nm. However, the three characteristic picks at 460, 510 and 570 nm occurred in all batches except the EDP at 80ºC. The control and the pâté with date at 80 ºC had nearly the same spectra, only SD ($P<0.05$) were found from 360 to 420 nm and from 610 to 730 nm, but for all wavelengths reflectance was very similar. During the thermal treatment, from 20 to 60 ºC, the higher differences between the control and the pâté with date occurred in the picks at 540, 570 and 620 nm, but at 80 ºC only the 570 nm pick was still appreciated.

IV. DISCUSSION

The decrease of L* from 20 to 40 ºC would be a consequence of thermal protein denaturation and modifications in the heme pigments structure. The tendency to increase L* from 40 to 80 ºC could be due to the protein coagulation, what did not occur in the DDP because was mainly fat. a* evolution was more similar between DL and the date pâté than for the control, but the addition of date only made it decrease in 4 units approximately, and probably decreased for the EDP due to the thermal degradation of carotenoids.

The addition of date to the pâté did not show SD for the b* values with the control, only at 80 ºC in 0.46 units, being impossible to detect it visually. C* and hº in the control and date pâté showed very similar values to those of Estévez [6], as well as for L* a* and b*.

Table 1. Colour parameters analysed during the thermal treatment of the six sample batches (mean values±standard error)
^{A,B,C,D,E,F} Values with different letters in the same column are significantly different (P<0.05)
^{a,b,c,d} Values with different letters in the same row are significant different (P<0.05)

	BATCH	20 ºC	40 ºC	60 ºC	80 ºC
L*	EDP	$^{B}50.19\pm0.33^{c}$	$^{B}44.86\pm0.53^{a}$	$^{B}47.97\pm0.28^{b}$	$^{B}50.99\pm0.06^{c}$
	DL	$^{C}54.63\pm0.27^{b}$	$^{C}52.57\pm0.14^{a}$	$^{C}52.76\pm0.12^{a}$	$^{C}53.96\pm0.18^{b}$
	LDP	$^{A}36.61\pm0.09^{a}$	$^{A}36.55\pm0.22^{a}$	$^{A}43.16\pm0.24^{b}$	$^{A}50.35\pm0.10^{c}$
	DDP	$^{E}69.80\pm0.21^{d}$	$^{E}63.46\pm0.23^{c}$	$^{E}61.50\pm0.17^{b}$	$^{E}60.13\pm0.10^{a}$
	Control	$^{D}60.96\pm0.09^{d}$	$^{D}54.47\pm0.08^{a}$	$^{D}55.22\pm0.10^{b}$	$^{D}56.31\pm0.22^{c}$
	Control+DP	$^{D}61.48\pm0.11^{c}$	$^{D}54.91\pm0.18^{a}$	$^{D}55.16\pm0.12^{a}$	$^{D}56.05\pm0.07^{b}$
a*	EDP	$^{E}6.82\pm0.15^{d}$	$^{C}5.09\pm0.19^{c}$	$^{B}4.47\pm0.07^{b}$	$^{B}3.30\pm0.02^{a}$
	DL	$^{B}3.86\pm0.07^{a}$	$^{D}5.97\pm0.08^{b}$	$^{C}5.78\pm0.06^{b}$	$^{E}8.99\pm0.03^{c}$
	LDP	$^{F}10.05\pm0.05^{a}$	$^{F}11.28\pm0.15^{b}$	$^{E}10.92\pm0.11^{b}$	$^{F}11.05\pm0.04^{b}$
	DDP	$^{A}-0.14\pm0.05^{a}$	$^{A}0.36\pm0.04^{b}$	$^{A}1.36\pm0.07^{c}$	$^{A}2.47\pm0.03^{d}$
	Control	$^{D}5.21\pm0.02^{a}$	$^{E}6.56\pm0.06^{b}$	$^{D}7.43\pm0.05^{c}$	$^{D}8.33\pm0.12^{d}$
	Control+DP	$^{C}4.19\pm0.04^{ab}$	$^{B}4.06\pm0.06^{a}$	$^{B}4.35\pm0.05^{b}$	$^{C}7.73\pm0.03^{c}$
b*	EDP	$^{E}21.65\pm0.43^{c}$	$^{B}15.07\pm0.70^{b}$	$^{B}14.82\pm0.28^{b}$	$^{B}12.87\pm0.09^{a}$
	DL	$^{C}17.25\pm0.12^{d}$	$^{D}16.80\pm0.10^{c}$	$^{BC}15.44\pm0.12^{b}$	$^{C}13.37\pm0.07^{a}$
	LDP	$^{B}15.05\pm0.11^{b}$	$^{B}14.30\pm0.22^{a}$	$^{B}14.92\pm0.15^{b}$	$^{E}14.59\pm0.08^{ab}$
	DDP	$^{A}11.68\pm0.09^{bc}$	$^{A}11.93\pm0.08^{c}$	$^{A}11.59\pm0.08^{b}$	$^{A}10.56\pm0.04^{a}$
	Control	$^{D}18.32\pm0.08^{d}$	$^{D}17.87\pm0.06^{c}$	$^{BC}15.37\pm0.11^{b}$	$^{C}13.40\pm0.10^{a}$
	Control+DP	$^{CD}17.87\pm0.11^{c}$	$^{D}17.46\pm0.09^{c}$	$^{C}15.69\pm0.14^{b}$	$^{D}13.86\pm0.09^{a}$
C*	EDP	$^{E}22.70\pm0.46^{c}$	$^{B}15.91\pm0.73^{b}$	$^{B}15.48\pm0.29^{b}$	$^{B}13.29\pm0.09^{a}$
	DL	$^{B}17.68\pm0.12^{b}$	$^{C}17.84\pm0.10^{b}$	$^{CD}16.49\pm0.13^{a}$	$^{D}16.12\pm0.06^{a}$
	LDP	$^{B}18.10\pm0.10^{a}$	$^{C}18.23\pm0.19^{a}$	$^{E}18.50\pm0.14^{a}$	$^{E}18.31\pm0.08^{a}$
	DDP	$^{A}11.68\pm0.09^{b}$	$^{A}11.93\pm0.08^{b}$	$^{A}11.68\pm0.08^{b}$	$^{A}10.85\pm0.04^{a}$
	Control	$^{D}19.05\pm0.08^{c}$	$^{C}19.04\pm0.06^{c}$	$^{D}17.08\pm0.09^{b}$	$^{C}15.79\pm0.07^{a}$
	Control+DP	$^{CD}18.36\pm0.11^{b}$	$^{C}17.93\pm0.09^{b}$	$^{C}16.28\pm0.14^{a}$	$^{CD}15.87\pm0.08^{a}$
hº	EDP	$^{B}72.51\pm0.12^{b}$	$^{C}71.20\pm0.21^{a}$	$^{D}73.18\pm0.05^{c}$	$^{E}75.58\pm0.12^{d}$
	DL	$^{D}77.39\pm0.19^{d}$	$^{BC}70.42\pm0.25^{c}$	$^{C}69.48\pm0.15^{b}$	$^{B}56.06\pm0.19^{a}$
	LDP	$^{A}56.23\pm0.23^{c}$	$^{A}51.70\pm0.58^{a}$	$^{A}53.77\pm0.41^{b}$	$^{A}52.85\pm0.18^{ab}$
	DDP	$^{E}90.73\pm0.26^{d}$	$^{E}88.25\pm0.22^{c}$	$^{F}83.29\pm0.37^{b}$	$^{F}76.84\pm0.14^{a}$
	Control	$^{C}74.10\pm0.09^{d}$	$^{B}69.84\pm0.19^{c}$	$^{B}64.15\pm0.28^{b}$	$^{C}58.12\pm0.51^{a}$
	Control+DP	$^{D}76.78\pm0.14^{c}$	$^{D}76.89\pm0.19^{c}$	$^{E}74.47\pm0.16^{b}$	$^{D}60.83\pm0.20^{a}$

The mentioned picks from 650 nm could be a characteristic of liver, what is related to the spectra red area [4]. The picks at 540 and 570 nm are related to the heme pigment, being characteristic of the cured meat products. Here may be due to the presence of heme pigments from the liver, together with the curing agents.

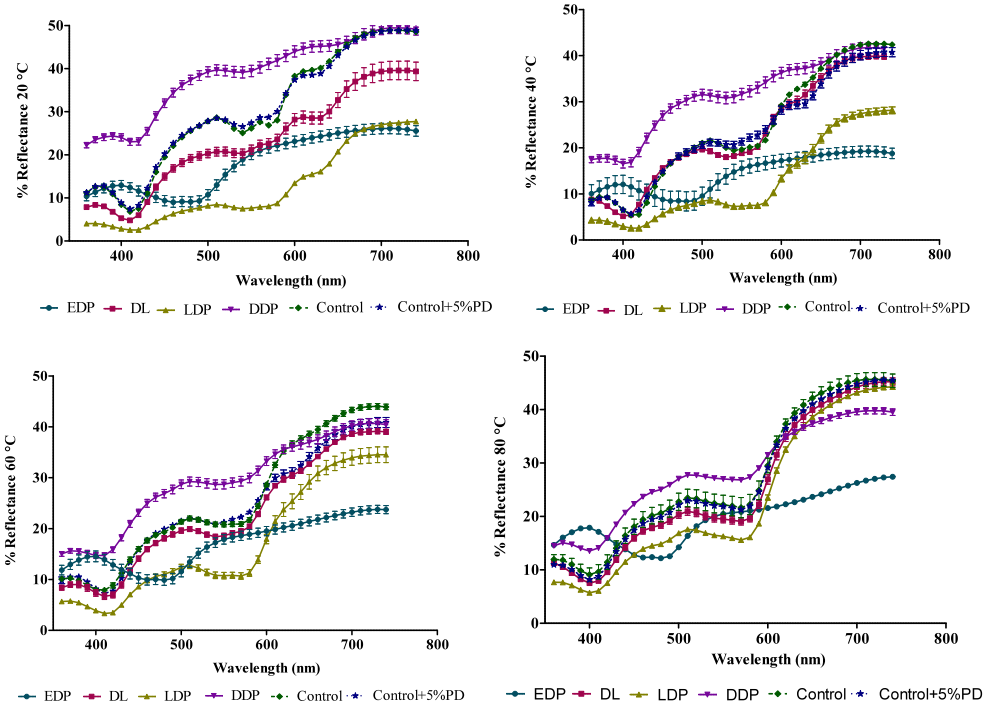

Fig. 1 Reflectance spectra of all samples at studied temperatures

V. CONCLUSIONS

The addition of 5% paste from dates palm in pork liver pâté did not affect the reflectance spectra shape and colour properties very significantly. Therefore, the date paste could be integrated in the product correctly. Thereby, fresh dates at 5% could be used as an ingredient in cooked meat products, such as pâté.

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