71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

INSTRUMENTAL COLOR STABILITY OF FROZEN BEEF BURGERS IN DIFFERENT PACKAGINGS

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I. INTRODUCTION

Color is one of the most important factors consumers consider when evaluating meat quality, as it significantly influences their perception of freshness, a key element in purchasing decisions. The change in meat colour is closely associated with the oxidation of pigments and lipids [1]. Oxidation reactions favour the formation of metmyoglobin, which has a greyish-brown colouration, which reduces the product's attractiveness [2]. Antioxidants are used in fresh and processed meat to prevent lipid oxidation and improve colour stability. Both onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) have strong antioxidant properties due to their phenolic compounds [3]. When used to prepare biodegradable films, they can maintain quality, increase shelf life and improve the sensory properties of foods [4]. This study aimed to evaluate the colour changes in beef hamburgers and to evaluate the effect of packaging with an edible film made from a combination of onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) pulp, low-density polyethene plastic film (LDPE) and paper.

II. MATERIALS AND METHODS

The burgers were made from two cuts of beef: flank (which includes the *Vastus intermedius*, *Vastus lateralis*, *Vastus medialis*, and *Rectus femoris*) and brisket (*Pectoralis profundus*). The proportions used were 61.5% flank and 38.5% brisket, with the addition of 0.7% salt and 3% water. The meats were ground in a grinder (CAF - model 106), with an 8 mm and 5 mm disc for the flank and brisket respectively They were then reground in a 12 mm disc for homogenisation of the samples. The onion and garlic film was produced using Mathis equipment (KTF-B pilot machine for film coating) from a 4:1 ratio of onion and garlic pulp, respectively. Pulps were obtained from 5 kg of onion and 1 kg of garlic and distilled water was added in a 1:1 ratio. They were then heat treated in a vertical autoclave (AV 50 Phoenix Scientific Equipment) at 121°C at 1.3 kgf/cm3 for 30 minutes. The hamburgers were prepared at a temperature of -1.6 to -2°C. Afterwards, the hamburgers were divided into three treatments: 1. control (no film), 2. onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) edible film and 3. paper. The samples were frozen then at -40°C for an average time of 30 minutes and were stored at -25°C until analysis. A portable colorimeter (Konica Minolta CM-25d) operating in the CIELab system (L*, a*, b*; C*; h) with a D65 illuminant, 10° observer, was used for instrumental colour analysis. Five samples from each treatment were analysed at 0, 30, 60, 90 and 120 days in 5 different points. Before analysis, samples were removed from the freezer and exposed to air at room temperature for 30 minutes. The data was analysed by analysis of variance (ANOVA), and the means were compared using the SNK test when the ANOVA was significant ($p<0.05$) by the XLSTAT program (2012).

III. RESULTS AND DISCUSSION

The colour of beef burgers was affected by both packaging and storage time ($p<0.05$) and showed a packaging x time interaction ($p<0.05$). Burgers packaged in onion/garlic film showed stable values over time for all the colour parameters if compared to the other treatments. When comparing treatments each time, for L*, treatments with onion/garlic film showed lower values than control and paper treatments from 30 days; a* parameter was higher in the onion/garlic packaging if compared to control at 90 and 120 days and b* showed higher values than the other packagings in each time from 30 days. The C* values from the onion/garlic treatment were higher than the control and paper treatment for 60 days, and h was higher than the other treatments, only at 30 days. Regarding onion/garlic treatment, lower values of L* indicate less darkening of the samples, while higher a* values the stability of the red colour. It is important to note that the onion/garlic film is yellowish (b*), which was maintained. Croma indicates the

colour saturation and onion/garlic treatment showed higher values and h, which indicate shifts in colour over time toward discolouration [5]; the values found were statistically ($p>0.05$) the same over the studied times.

Table 1 - Average values of L*, a*, b*, C* and h of beef burgers in different treatments and times

Parameters	Packaging	Time (days)				
		0	30	60	90	120
L*	Control	48.17^{cd}	49.56^{c}	47.95^{cd}	48.63^{cd}	51.93^{b}
	Paper	48.17^{cd}	48.90^{c}	48.61^{cd}	49.66^{c}	54.02^{a}
	Onion/garlic film	48.17^{cd}	44.03^{e}	43.38^{e}	43.23^{e}	43.10^{e}
a*	Control	22.39^{a}	16.45^{bc}	14.35^{defg}	11.46^{hi}	11.67^{hi}
	Paper	22.39^{a}	15.99^{bcd}	12.57^{gh}	11.26^{hi}	10.35^{i}
	Onion/garlic film	22.39^{a}	15.83^{bcde}	14.97^{bcdef}	14.04^{efg}	14.63^{cdef}
b*	Control	21.41^{a}	19.49^{bc}	18.46^{cd}	16.07^{f}	18.24^{cde}
	Paper	21.41^{a}	18.26^{cde}	17.02^{def}	16.92^{ef}	18.59^{c}
	Onion/garlic film	21.41^{a}	21.23^{a}	20.52^{ab}	20.31^{ab}	20.57^{ab}
C*	Control	31.00^{a}	25.52^{bc}	23.43^{def}	19.77^{h}	21.73^{fgh}
	Paper	31.00^{a}	24.32^{cde}	21.21^{gh}	20.35^{h}	21.33^{gh}
	Onion/garlic film	31.00^{a}	26.51^{b}	25.41^{bc}	24.70^{bcd}	25.25^{bcd}
h	Control	43.73^{f}	49.88^{e}	52.64^{d}	54.81^{bcd}	57.53^{b}
	Paper	43.73^{f}	49.06^{e}	53.92^{cd}	56.48^{bc}	60.66^{a}
	Onion/garlic film	43.73^{f}	53.27^{cd}	53.89^{cd}	55.40^{bcd}	54.54^{bcd}

^{abcdefgh} Values in lowercase letters differ ($p<0,05$) between packaging/time combinations for each variable

IV. CONCLUSION

Frozen beef burgers packaged with onion/garlic film presented better colour stability during the analysed time, thus being considered a promising packaging with favourable properties for more significant colour conservation in these products.

ACKNOWLEDGEMENTS

This study was financed by FAPESP (process 2023/03583-9) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

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