PE8.13 Effects of packing and ageing on shelf life of rabbit hamburgers from 'organic' and 'commercial' production system 80.00

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Abstract-

The short shelf life of packed refrigerated hamburgers is one of the main problems in its commercialisation. An approach to overcoming the problem is to use vacuum packing in order to preserve a fresh appearance and delay microbial growth and lipid and pigment oxidation. Rabbit hamburguers were made from rabbit meat of two different production systems: organic and commercial ways. Chilled hamburgers (4°C ± 1), packed with or without vacuum were analyzed at 1, 5, 8 and 12 days of elaboration (6 hamburgers / production system / packing / day). The 'commercial' origin and the 'without vacuum packaging' resulted in more luminosity burgers while for cooked hamburgers, the luminosity was higher at higher storaged time. After cooking, the parameter a* was higher in the 'organic' burgers and for the vacuum packaging; the chroma (C*) decreased from the 8th day of refrigeration. For fatty acids, the most influential factor was the production system; 'organic' burgers showed a n6/n3 rate optimal for human consumption. The rancid odour was very low for vacuum packaging. In raw hamburgers, with the longer storaged time, there was an increase of 'odour intensity' but declined the characteristic smell of rabbit. From 5 to 8 days, 'rabbit flavour' decreased and 'rancid flavour' increased significantly and caused rejection at 12 days of storage (no acceptance to be aten). The vacuum packaging determined more 'rabbit flavour' and less rancidity ($p > 0.05$) but higher 'liver flavour' and greater juiciness ($p < 0.05$). As a conclusion, nutritive value differences were observed in n6/n3 relation, optimun in the 'organic' production system. Vacuum packaging ensured good eating quality of rabbit hamburgers until 8 days of refrigeration but was unable to mantain the shelf life until 12 days of storage under refrigerating conditions.

Key words: rabbit, hamburgers, production system, packing, ageing.

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I. INTRODUCTION

The current consumer interest shown by the quality and nutritional value of foods, results in an increasingly selective demand and a growing need for differentiation of products [1]. For some time the European population has turned to the production of more environmentally friendly and animal welfare, such as organic production, which consumers perceive as safer [2]. Argentina has the productive conditions of easy conversion to an organic production system. The consumption of rabbit meat in Argentina is very low (100g / habitant / year; SENASA -Servicio Nacional de Seguridad y Calidad Agroalimentaria- Argentina); fluctuations of the export market for this meat is forcing breeders to look at the development of the domestic market demand for easy meal preparation (hamburgers, 'ready to cook', etc.). Meat quality is defined as a combination of traits that provide an edible product that is attractive, appetizing, nutritious and palatability after cooking [3]. The short shelf life of packed refrigerated hamburgers is one of the main problems in its commercialisation. The freshness of

meat is affected by lipid oxidation, which is considered as a major nonmicrobiological factor involved in quality deterioration of meat [4]. An approach to overcoming the problem of limited shelf life is to use vacuum packing, in order to preserve a fresh appearance and delay microbial growth and lipid and pigment oxidation in refrigerated hamburgers.

Therefore the objective of this study was to assess the effects of packing and ageing of the eating quality of hamburgers from meat rabbits reared under organic or commercial production systems.

II. MATERIALS AND METHODS

Hamburgers were prepared from rabbit meat proceeded from two production systems: organic and commercial (slaughter weight: 2.3-2.5 kg). Chilled burgers (commercial refrigerator at 4°C ± 1), with or without vacuum packed (Multivax; Cryovac pouches of 100 microns) were analyzed at 1, 5, 8 and 12 days of elaboration (6 hamburgers / production system / packing / days). Fatty acids were extracted according to the technique described [5] and analyzed as methyl esters by gas chromatography (Shimatzu 14-B capilary column Resteck 2560). There were determined, the lipidic oxidation (TBAR's index; µg of malonaldehíde/ g meat) [6], the colour (CIELAB System, L* (lightness), a* (redness), b* (yelowness) and C* as $\gamma(a^{*2} + b^{*2})$), using a Minolta Chroma Meter-CR300 and the pH (Testo 205). The burgers were cooked in double contact grill to reach 71ºC ± 1ºC in the center of the sample (cold point), monitored by thermocouples. Cooking losses were determined by weight difference. The samples were analyzed by an analytical panel of 8 trained assessors according to international standards and experience in sensory analysis of meat [7] [8] [9] [10] [11]. Each assessor received samples (1x1x1m cubes) in containers coded with three digit random numbers. The following descriptors were assessed: the overall colour, brightness and odour on raw hamburgers while in cooked hamburgers were evaluated, the flavour, untuosity, juiciness and persistence, using an unstructured linear scale of 10 cm without anchorage. The ends of the scales corresponded to the intensity of the attribute: light pink, not bright, extremely soft, dry, not oily, low persistence (lower limit: 0) and red, shiny and extremely strong (intense), juicy, persistent, very oily (upper limit: 10). Statistical analysis of data was performed using the Proc Mixed of SAS (2004) for repeated measurements. Differences between treatments were analyzed by Tukey test ($p < 0.05$).

III. RESULTS AND DISCUSSION

For raw hamburgers, neither the origin of the meat (organic or commercial), nor the packaging (with or without vaccum) or the cooling time showed a clear influence on colour parameters and lipid oxidation due to the interaction between all factors (Table 1). The commercial 'origin'of meat and the packaging 'without vacuum' resulted in more light while for cooked burgers, the luminosity was higher at longer storaged time. After cooking, the parameter a* was higher in the 'organic' burgers and the vacuum packed but the chroma decreased from the 8th day of refrigeration. For fatty acids (Table 2) the most influential factor was the production system of origin; 'organic' hamburgers showed a n6/n3 relation optimal for human consumption [12] and in general there were no differences due to packaging or time of storage. The raw sensory colour (Table 3) showed the same interaction between factors; the individual analysis of the data showed more 'red' colour for the organic hamburgers, the packaging without vacuum and the longer storaged. The rancid odour was low in general and even less for vacuum packaging. With storage time, increased the 'intensity' of the odour but declined the characteristic 'rabbit' odour. From 5 to 8 days, rabbit flavour decreased and rancid flavour increased significantly and caused rejection at 12 days (no acceptance to be aten). The vacuum packaging determined more 'rabbit' flavor and less rancidity ($p > 0.05$) but higher 'liver flavour' and greater juiciness ($p < 0.05$). Organic or commercial origen of meat didn´t influence the sensory attributes of hamburgers.

IV. CONCLUSION

From these results, vacuum packaging ensure good eating quality of rabbit hamburgers up to 8 days of storage under refrigerating conditions but it is not possible to extend the shelf life until the proposed 12 days. Nutritive value differences were observed in n6/n3 ratio, optimun for the organic production system. It is suggested that future research work should envisage other metodologies (frozen, modified atmosphere) for longer ageing periods of hamburgers from different production systems.

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Table 1. Effect of packing and ageing on cooking loss, pH, colour and TBAR's of 'organic' and 'commercial' rabbit hamburgers

Traits	Treatment (T)		Packing (P)		Days (D)				Probability							St. error
	C	O	V	NoV	1	5	8	12	T	P	D	TxP	TxD	PxD	TxPxD	
Raw hamburgers																
pH	6.04	5.87	5.93	5.98	5.93ab	6.00a	5.97a	5.85b	<.0001	0.0062	<.0001	ns	ns	ns	ns	0.04
L*	64.4	57.6	58.1	60.9	63.1b	59.7b	57.8a	59.0b	Sig.	Sig.	0.0004	0.0106	ns	ns	ns	2.18
a*	7.94	12.1	11.6	8.41	9.24	9.36	10.5	11.1	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	0.0023	1.21
b*	13.1	8.00	8.50	12.6	13.1	11.1	9.74	8.41	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	<.0001	0.94
C*	15.8	14.6	14.6	15.8	17.1	15.3	14.7	14.1	Sig.	ns	Sig.	Sig.	Sig.	Sig.	<.0001	1.24
TBAR'S μg/g	5.49	1.90	3.57	3.83	2.97	3.52	3.90	4.39	Sig.	Sig.	Sig.	Sig.	Sig.	ns	0.0056	0.38
Cooked hamburgers																
Cooking loss %	24.8	23.3	24.0	24.2	23.7a	22.5a	26.6b	22.5a	ns	ns	0.0173	ns	ns	ns	ns	3.89
L*	68.5	66.9	67.9	67.5	66.3a	66.2a	69.9b	67.5ab	ns	ns	0.0102	ns	ns	ns	ns	3.21
a*	6.07	7.54	7.80	5.81	5.52	7.31	6.33	8.03	0.0001	0.0001	ns	ns	ns	ns	ns	1.21
b*	16.1	16.6	15.2	17.6	18.1	18.1	14.9	14.0	ns	ns	ns	ns	ns	ns	ns	3.56
C*	17.3	18.4	17.1	18.6	18.9b	19.7b	16.3a	16.2a	ns	ns	0.0488	ns	ns	ns	ns	3.54

Treatment: C: commercial, O: organic; Packing: V: vacuum, NoV: without vacuum

Table 2. Effect of packing and ageing on faty acid profile (%tot.FA) of ‘organic’ and ‘commercial’ rabbit hamburgers

Traits	Treatment (T)		Packing (P)		Days (D)				Probability							St. error
	C	O	V	NoV	1	5	8	12	T	P	D	TxP	TxD	PxD	TxPxD	
C 16:0	29.4	32.4	30.3	31.4	32.3 a	30.7 b	30.7 b	30.2 b	Sig.	ns	0.0314	<.0001	ns	ns	ns	0.67
C 18:0	7.17	8.39	7.81	7.76	7.88	7.41	7.82	8.33	0.0002	ns	ns	ns	ns	ns	ns	0.74
C18:1	25.2	25.6	25.6	25.2	25.7	25.5	25.0	25.8	ns	ns	ns	ns	ns	ns	ns	1.39
C18:2	25.2	18.9	22.4	21.6	19.4 a	22.2 b	23.2 b	21.9 b	<.0001	ns	0.0046	ns	ns	ns	ns	1.61
C18:3	2.78	4.27	3.53	3.52	3.86	3.30	3.63	3.44	0.0001	ns	ns	ns	ns	ns	ns	0.75
C20:4	0.99	1.27	1.17	1.09	0.92	1.27	0.98	1.36	ns	ns	ns	ns	ns	ns	ns	0.45
C20:5	0.32	0.22	0.25	0.29	0.40	0.30	0.21	0.22	ns	ns	ns	ns	ns	ns	ns	0.13
C22:5	0.16	0.26	0.20	0.22	0.17	0.23	0.25	0.13	0.0110	ns	ns	ns	ns	ns	ns	0.08
C22:6	0.03	0.03	0.03	0.04	0.05	0.03	0.04	0.02	ns	ns	ns	ns	ns	ns	ns	0.02
SAT[1]	40.2	44.7	41.8	43.1	42.6	42.6	42.4	42.2	Sig.	Sig.	ns	0.0223	ns	ns	ns	1.00
MUFA[2]	28.5	29.3	29.0	28.8	29.6	28.8	28.5	29.3	ns	ns	ns	ns	ns	ns	ns	1.54
PUFA[3]	31.2	26.0	29.1	28.1	27.8	28.6	29.1	28.5	<.0001	ns	ns	ns	ns	ns	ns	1.39
n6/n3	8.84	4.51	6.27	7.09	7.13	6.55	6.71	6.43	<.0001	0.0486	ns	ns	ns	ns	ns	0.86

Treatment: C: commercial, O: organic; Packing: V: vacuum, NoV: without vacuum
SAT[1] saturated fatty acids; MUFA[2] momounsaturated fatty acids; PUFA[3] polyunsaturated fatty acids

Table 3. Effect of packing and ageing on sensory attributes of raw and cooked 'organic' and 'commercial' rabbit hamburgers

Traits	Treatment (T)		Packing (P)		Days (D)				Probability							St. error
	C	O	V	NoV	1	5	8	12	T	P	D	TxP	TxD	PxD	TxPxD	
Raw hamburgers																
Colour	1.30	7.48	4.66	4.12	3.33	4.39	4.88	4.46	Sig.	ns	Sig.	ns	Sig.	Sig.	0.0192	1.06
Brightness	5.46	7.47	5.83	7.09	7.68	6.10	6.43	6.03	<.0001	ns	ns	ns	ns	ns	ns	1.82
Odour intensity	6.13	4.18	5.31	5.00	4.87 a	4.07a	5.46a	7.00 b	ns	ns	0.0192	ns	ns	ns	ns	2.46
Odour 'rabbit'	3.82	2.82	3.26	3.38	4.87 b	3.35a b	3.23a b	1.89 a	ns	ns	0.0272	ns	ns	ns	ns	2.57
Rancid Odour	1.00	0.16	0.39	0.77	0.62	0.25	0.94	0.49	Sig.	0.0042	ns	ns	ns	ns	ns	1.11
Cooked hamburgers																
Rabbit flavour	3.46	4.33	4.26	3.65	5.51 b	3.88a	3.10a	nd	ns	ns	0.0164	ns	ns	ns	ns	2.60
Rancid flavour	0.90	0.59	0.54	0.88	0.24 a	0.29a	1.45b	nd	ns	ns	0.0025	ns	ns	ns	ns	1.21
Liver flavour	0.98	0.75	1.6	0.37	0.19	0.94	1.12	nd	ns	0.0308	ns	ns	ns	ns	ns	1.64
Untuosity	3.33	3.39	3.53	3.25	4.34 b	2.63a	3.61a b	nd	ns	ns	0.0305	ns	ns	ns	ns	1.94
Juiciness	4.78	4.55	4.95	4.48	5.42 b	4.87a b	4.09a	nd	ns	0.0229	0.0040	ns	ns	ns	ns	1.27
Persistency	5.39	5.43	5.81	5.14	5.35	5.36	5.50	nd	ns	ns	ns	ns	ns	ns	ns	2.83

Treatment: C: commercial, O: organic; Packing: V: vacuum, NoV: without vacuum
nd: No determined