EFFECTS OF THE ADDITION OF ACETYLATED MONOGLYCERIDE ON THE MICROFLORA, WEIGHT LOSSES AND COLOR BLOOM OF VACUUM PACKAGED BEEF.

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Introduction: During meat refrigerated storage microbial counts could increase, causing physical, chemical and microbiological alterations which affect the final quality of the product, thus shelf-life. In order to improve sensorial characteristics and increase shelf-life, the use of vacuum package in meat industry is considered peacemaker (RIZVI, 1981).
Many edible coatings were studied to cause a decrease on microbial counts and/or on the weight losses and improve sensorial characteristics during storage of vacuum packaged meat. One edible coating-acetylated monoglyceride-used on beef, pork, lamb and poultry meat decreased weight losses but was reported to have no effect on the microbial deteriorative microflora (BARTELS et al., 1973; LIEBICH et al., 1986; KEETON et al., 1988).
This study was carried out to determine the effects of an acetylated monoglyceride (DFG-Dermatex Food Grade) on the deteriorative and pathogenic microbial counts, weight losses, pH and color bloom during refrigerated storage of vaccum packaged brazilian striploin.

Material and Methods: 84 cuts of Longissimus (pH < 5.8) with an average weight of 900g were vacuum packaged (27 in Hg) in commercially coextruded films "Barrier Bag" (oxigen transmition rate OTR = 7.3mL/m²/day/1atm 75% RH) and "Bag Vac" (OTR = 10.4mL/m²/day/1atm 75% RH) (ASTM D 3985-81). Before packaging it was added 2% (w/w) DFG (Dermatex Food Grade) in 42 cuts. All cuts were randomly assigned in four treatments: A = "Barrier Bag"; B = "Barrier Bag" + 2% DFG; C = "Bag Vac"; D = "Bag Vac" + 2% DFG. Corrugated cardboard boxes were used as secondary package, and these were stored for 60 days at 0 ± 2°C.

Microbial counts: Surface sampling of 25 cm², using 3 samples per treatment/period, was performed every 12 days until the 36th day and every 8 days thereafter. Microbiological determinations included: aerobic mesophilic (APHA, 1976), psichrotropic (APHA, 1976), lactic acid bacteria (APHA, 1976), *Brochothrix thermosphacta* (GARDNER, 1966); *Clostridium perfringens* (APHA, 1976); *Staphylococcus aureus* (APHA, 1976); *Yersinia enterocolitica* (MEHLMAN et al., 1978). *Salmonela* detection was carried out on 25g of 3 samples per treatment/period (APHA, 1976).
Weight losses: All samples were weighted before packaging and after storage period, once the meat pieces were wiped. Differences on weight were computed as weight losses.
Color bloom was visually evaluated on a lean surface after exposure to cold air for 20 minutes. The panelists were asked to give a score from zero (very bad) to five (excellent) for lean color.
pH determination was carried out in a blend of 3g of sample with 27mL of destilated water with a MICRONAL pHMeter.
Data were analysed by analysis of variance on log counts of individual samples. When mean counts were different the technique of Duncan was employed for mean separation.

Results and Discussion:
Microbial evaluation: With few exceptions, no differences ($p > 0.05$) were observed among treatments within period on the mean counts of aerobic mesophilic, psichrotrophic and lactic acid bacteria (TAbles 1, 2 and 3). The last result do not agree with KEETON et al. (1988) that found differences ($p < 0.05$) on mean counts of lactic acid bacteria in vacuum packaged striploin with DFG. The higest increase in population of these microorganims (Tables 1, 2 and 3) was between the 12th and the 24th day of storage, and a lag phase was observed between zero and 12 days of storage. these results are similar to SEIDMAN et al. (1976) and CHRISTOPHER et al. (1980).
According to Table 1, the highest aerobic mesophilic mean counts was at the 52nd day for treatments A, B and C. For treatment D was at the 60th day. The highest count in

psichrotropic and lactic acid bacteria for all treatments wer observed at 52nd day of storage.

KEETON et al. (1988) detected the highest count for vacuum packaged striploin at the 49th day of storage and for the sample with DFG the highest count was at 35th day.

No differences ($p > 0.05$) was observed among treatments within period for B.thermosphacta (Table 4). The mean count values were between 0.22 and 2.16 (log CFU/cm²). At the end of storage a decrease in counts was detected for all treatments, results that are in agreement to CAMPBELL et al. (1979). On the contrary SIMMARD et al. (1983) found an increase of counts at the 49th day of storage in vacuum packaged beef. Between 12 and 24 days of storage the mean log counts of B.thermosphacta decrease while at the same time an increment in the mean log counts of lactic acid bacteria was observed for all treatments. This suggests an antagonism between these two microorganisms, which was also observed by ROTH and CLARK (1975).

C.perfringens was not detected (counts were < 1.00 log CFU/cm²) in all treatments and periods of storage. Perhaps the low storage temperature do not stimulated its development.

No differences ($p > 0.05$) were observed on S.aureus mean counts untel the 24th day (Table 5). From the 36th day no growth in culture medium was observed for all samples. KENNEDY et al. (1980) suggested that this decrease can be related to a sub-lethal cell injury under refrigerated conditions.

Salmonella and yersinia enterocolitica were not detected on the 84 samples analysed. The number of yersinia spp. isolated at 60 days of storage were 11; 22; 21 and 5 for treatments A, B, C and D, respectively. The only species found were Y.intermedia and Y.kristensenii.

Wheight losses increased rapidly between 0 and 24 days, varing from 0.34 to 4.19%. After this period weight losses were small until the 60th day (Table 6). For all treatments weight losses increased with the lenght of storage. These results are in agreement with SEIDMAN et al. 1976), LIEBICH et al. (1986) and KEETON et al. (1988). Although no differences ($p > 0.05$) were detected among treatments, weight losses were lower in those (B and D) which DFG was added. This denotes

Table 1. Aerobic mesophilic mean counts[1] (log CFU/cm²) on vacuum packaged striploin.

Period (days)	Treatments[2] A	B	C	D	Order of means[3]
0	2.72^{bc}	2.54^{bc}	2.21	2.32	ABCD
12	1.63^{c}	2.21^{c}	1.95	1.89^{b}	BCDA
24	4.68^{ab}	3.95^{abc}	4.51	3.63^{ab}	ACBD
26	5.37^{ab}	5.08^{ab}	5.65	5.44^{a}	CDAB
44	5.78^{a}	5.22^{ab}	5.60	5.59^{a}	ACDB
52	5.97^{a}	5.88^{a}	5.79	5.71^{a}	ABCD
60	5.51^{ab}	5.68^{a}	5.74	5.72^{a}	CDBA

1. 3 samples/treatment
2. A="Barrier Bag"; B="Barrier Bag" + 2% DFG; C="Bag Vac"; D="Bag Vac" + 2% DFG.
3. Mean counts in the same row with a common underline do not differ (p 0.05).
a, b, c = mean counts in the same columm with a common letter do not differ.

Table 2. Psichrotrophic mean counts[1] (log CFU/cm²) on vacuum packaged striploin.

Period (days)	Treatments[2] A	B	C	D	Order of means[3]
0	3.34^{ab}	2.92^{ab}	3.16^{ab}	2.68^{c}	ACBD
12	1.82^{b}	2.26^{b}	1.26^{b}	1.39^{c}	BADC
24	3.75^{ab}	3.89^{ab}	4.41	3.67^{abc}	CBAD
36	5.33^{a}	5.12^{a}	5.61	5.23^{ab}	CADB
44	5.81^{a}	5.14^{a}	5.59	5.52^{ab}	ACDB
52	5.86^{a}	5.69^{a}	5.78	5.63^{a}	ACBD
60	5.66^{a}	5.56^{a}	5.40	5.38^{ab}	ABCD

To legend see Table 1.

Table 3. Lactic acid bacteria mean counts (log CFU/cm²) on vacuum packaged striploin.

Period (days)	Treatments[2]				Order of means[3]
	A	B	C	D	
0	1.30^{b}	2.04^{b}	1.71^{b}	1.81^{b}	BDCA
12	1.31^{b}	1.89^{b}	1.23^{b}	1.00^{b}	BACD
24	4.63^{a}	3.19^{ab}	3.49^{ab}	3.64^{ab}	ADCB
36	4.94^{a}	4.90^{ab}	5.59^{a}	5.61^{a}	DCAB
44	5.07^{a}	4.72^{ab}	5.17^{a}	5.60^{a}	DCAB
52	5.69^{a}	5.69^{a}	6.29^{a}	5.63^{a}	CABD
60	5.60^{a}	5.46^{a}	5.37^{a}	5.45^{a}	ABDC

To legend see Table 1.

Table 4. Brochothrix thermosphacta mean counts (log CFU/cm²) on vacuum packaged striploin.

Period (days)	Treatments[2]				Order of means[3]
	A	B	C	D	
0	<2.00*	<2.00	<2.00	<2.00	
12	<2.00	<2.00	<2.00	<2.00	
24	0.22^{a}	0.83^{a}	1.79^{a}	0.41^{b}	CBDA
36	0.38^{a}	0.43^{a}	1.21^{a}	0.92^{a}	CBDA
44	2.16^{a}	0.99^{a}	0.83^{a}	1.16^{a}	ADBC
52	1.22^{a}	1.50^{a}	1.61^{a}	0.74^{a}	CBAD
60	0.33^{a}	0.76^{a}	1.36^{a}	0.60^{a}	CBDA

* logaritimic of estimated count. To legend see Table 1.

Table 5. Staphylococcus aureus mean counts[1] (log CFU/cmz) on vacuum packaged striploin.

Period (days)	Treatments[2]				Order of means[3]
	A	B	C	D	
0	0.75^{a}	1.43^{a}	1.57^{a}	1.12^{a}	CBDA
12	2.05^{a}	1.29^{a}	2.12^{a}	0.97^{a}	CABD
24	1.26^{a}	1.43^{a}	1.60^{a}	1.36^{a}	CBDA
36	<2.00	<2.00	<2.00		
44	<2.00	<2.00	<2.00		
52	<2.00	<2.00	<2.00		
60	<2.00	<2.00	<2.00		

To legend see Table 1.

Table 6. Weight losses percentage[1] on vacuum packaged striploin.

Period (days)	Treatments[2]				Order of means[3]
	A	B	C	D	
0	1.46^{c}	0.34^{c}	1.99^{c}	0.89^{b}	CADB
12	3.02^{a}	1.57^{bc}	3.23^{c}	2.62^{ab}	CADB
24	4.19^{a}	2.76^{ab}	4.13^{ab}	3.53^{a}	ACDB
36	4.28^{a}	2.83^{ab}	4.94^{ab}	3.35^{ab}	CADB
44	4.88^{a}	3.27^{a}	5.32^{a}	3.97^{a}	CADB
52	4.25^{a}	3.82^{a}	5.02^{ab}	4.89^{a}	CDAB
60	4.42^{a}	3.94^{a}	5.99^{a}	4.69^{a}	CDAB

To legend see Table 1.

Table 7. Color bloom evaluation[1] on vacuum packaged striploin.

Period (days)	Treatments[2]			
	A	B	C	D
0	5.00[a]	5.00[a]	5.00[a]	5.00[a]
12	4.67[a]	4.67[a]	4.50[a]	4.30[a]
24	4.83[a]	4.67[a]	4.83[a]	4.83[a]
36	4.50[a]	4.50[a]	4.67[a]	5.00[a]
44	4.67[a]	4.67[a]	4.67[a]	4.83[a]
52	4.50[a]	4.17[a]	4.50[a]	4.17[a]
60	4.67[a]	5.00[a]	4.67[a]	4.67[a]

1. After expure to cold air for 20 minutes; zero (very bad) and 5 (excellent); mean of 3 samples per treatment.
2. To legend see Table 1.
a. means on the same row with a common letter do not differ (p 0.05).

a positive effect of DFG on reducing weight losses and agree with KEETON et al. (1988).

pH determination: during storage period there was a decline in pH for all treatments, varing from 5.57; 5.63; 5.55 and 5.57 (zero day) and 5.48; 5.46; 5.43 and 5.44 (60[th] day) for treatments A, B, C and D, respectively, but no differences ($p > 0.05$) were detected among treatments within period.

The highest decrease was observed between 12 and 24 days, which was coincident to the highest increase of lactic acid bacteria. This suggests that may exist an inverse relation between these microorganisms and pH.

Results of color bloom are presented in Table 7. No differences ($p > 0.05$) were detected among treatments within periods which agree with o GRIFFIN et al. (1982). In the othee hand KEETON et al. (1988) reported differences ($p < 0.05$) at the 28[th] day of storage, with an advantage for tretment which DFG was added.

Conclusions: The addition of DFG did not affected the deteriotative and pathogenic microflora, pH and color bloom of vacuum packaged brazilian striploin during 60 days of refrigerated storage.

Although weight losses tended to be lower in those treatments with DFG, the cost of its application as a edible coating for beef should be evaluated.

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