STABILITY OF BEEF PREBLEND

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INTRODUCTION

In the process of preblending, salt (NaCl), water, and Nitrite ($NaNO_2$) are added to ground meat and, after mixing, the product is stored for a variable length of time before it is used in emulsion type sausages. The objective of preblending is to gain time for the chemical analysis necessary to obtain a uniform product as well as to adjust the finished product to legal requirements. Kramlich et al. (1973) included among the advantages of preblending the ability to stabilize meat from the point of view of microbial spoilage and retarding fat oxidation in the raw material.

Microbial growth is inhibited in preblends by the salt and nitrite included. The role of salt as an inhibitory factor of microbial growth has been reviewed by Ingram and Kitchell (1967). Salt leads to the inhibition of the normal flora developing in meat at refrigeration temperatures, the pseudomonas group being more sensitive than other groups like micrococcus (Lin et al., 1977). Smith and Palumbo (1973) showed that when aging beef for bologna manufacture, the level of salt is critical. Nitrite also has an inhibitory effect on microorganisms. It is recognized that nitrite ions has an influence on the inhibition of C. botulinum (Wolff & Wasserman, 1972), but nitrite has also been reported to be inhibitory to many other species of bacteria (Ingram, 1973). Terrell (1974) concluded that preblends should not be prepared without nitrite.

Salt enhances oxidative rancidity in cured meat and nitrite has an inhibitory effect in this process. Although there are many references to the lypolitic and oxidative processes taking place in dried sausages (Nurmi and Niinivaara, 1964; Alford et al., 1971; Demeyer et al., 1974) there is a lack of data in relation to rancidity in preblended products.

The objectives of this study were to evaluate the microbial stability and rancidity development during storage at three different temperature conditions of beef preblends prepared with two levels of salt.

EXPERIMENTAL

Lean beef trimmings (5-10% fat) were finely ground twice through an 1/8" (3.2 mm) plate and after mixing to obtain a uniform batch, it was subdivided to form two separate lots. To each of these lots, 20% water, 75 ppm of nitrite and either 3% or 6% salt, was added. After mixing the ingredients, the two lots were subdivided into 10 samples. One sample from each salt level was analyzed immediately after preparation and the remaining samples were stored at -10°C, or 0°C or 15°C. The samples were analyzed once a day from each storage temperature for the following three days. The procedure was repeated four times.

Total count was determined on Tryptone Glucose Extract Agar (Difco) and evaluated as described by Ockerman (1980), except that a stomacher was used to disintegrate the samples, as described by Emswiler et al. (1977). Plates were incubated at 25°C for 4-5 days. The original method of Tarladgis et al. (1960) was used to determine TBA values. Residual nitrite was evaluated by the colorimetric method described by Ockerman (1980). Data were submitted to analysis of variance by the Least Square and Maximum Likelihood General Purpose Program of Harvey (1968). Mean separation was accomplished by the Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

There was a significant three ways interaction for the amount of added salt, storage temperature and length of storage time on the microbiological population of the beef preblends ($P<.0001$), as presented in the overall analysis of variance as shown in Table 1.

Table 1 - Degree of significance of the F values in the overall analysis of variance

Main effect	Log. of total count	TBA values	Residual nitrite
Salt, linear	.1125	.0000	.5816
Temperature			
Linear	.8176	.1038	.0550
Quadratic	.0000	.0000	.0000
Length of storage			
Linear	.0000	.1204	.0000
Quadratic	.7128	.2901	.1928
Cubic	.0186	.6152	.8249
Salt X temperature	.4219	.0840	.5280
Salt X length of storage	.8135	.0738	.2940
Temperature X length of storage	.0000	.0932	.0000
Salt X Temp. X length of storage	.0001	.9997	.0001

Table 2 presents the least square mean values for the logarithms of the total microbiological count during storage in 3% and 6% salt added preblends at the three different temperature conditions. There was a continuous increase in the microbial population in samples stored at 15°C, this increase being significant after 2 days of storage. Values for microbiological content in 3% salt added preblends stored at 15°C were higher than those for the 6% salt added preblends during the entire storage period; however, at each corresponding day these differences were not large enough to be significant. Therefore, it appears that increasing the amount of salt to 6% compared to 3% did not have any significant inhibitory effect on the microbiological growth.

Samples stored at 0°C and -10°C did not show any significant change in the microbiological population during 4 days storage. It seems that microbes that could develop at these temperatures are inhibited by the added salt and/or nitrite.

The amount of added salt had a significant effect on TBA values as shown by analysis of variance in Table 1. The overall least square means of TBA values in the 3% salt added preblends was 0.67 and this was significantly lower than the 0.88 TBA value of the 6% salt added samples. The temperature of storage also had a highly significant effect on TBA values. Presented in Table 3 are the least square means for the TBA values from samples stored at different temperatures. Samples stored at 15°C resulted in significantly higher values than those stored at lower temperatures. Although samples stored at -10°C presented lower values than those stored at 0°C, this difference was not significant. The overall TBA values profile can be explained as one of the values being temperature dependent and consequently rancidity developed faster as the temperature increased but also at higher temperature there was an increase in microbiological numbers and a decrease in residual nitrite, both of which probably accelerated oxidation. It was surprising that length of storage did not have a significant effect on rancidity development. Possibly it is due to the fact that the length of storage was too short for this effect to become apparent.

Table 2 - Least squares means of the logarithms of the total microbial count in beef preblends during storage

Storage temperature	3% Salt added			6% Salt added		
	-10°C	0°C	15°C	-10°C	0°C	15°C
Day						
1	5.7815[a]	5.7815[a]	5.7815[a]	5.7505[a]	5.7505[a]	5.7505[a]
2	5.5988[a]	5.7441[a]	6.5412[a]	5.5447[a]	5.5558[a]	5.8432[a]
3	5.6839[a]	5.7451[a]	8.1243[b]	5.6620[a]	5.6290[a]	7.7652[b]
4	5.6550[a]	5.6759[a]	8.5440[b]	5.5910[a]	5.6189[a]	8.2128[b]

[a,b] Means in the same column with the same suprascript letter are not significantly different (P>0.5).

Table 3 - Least squares means (LSM) and standard errors (SE) of TBA values of beef preblends

Holding conditions	LSM	SE
-10°C	0.69[b]	0.03
0°C	0.76[b]	0.03
15°C	0.89[a]	0.03

[a,b] Means with the same suprascript letter are not significantly different (P>0.5).

There was a significant three ways interaction for the amount of added salt, storage temperature and length of storage on the residual nitrite levels in the preblended products, as shown in Table 1. The least square means for nitrite values for the beef preblends with 3% and 6% added salt during storage at the three different storage temperatures are presented in Table 4. The residual nitrite of preblends stored at 15°C (both 3% and 6% added salt) was reduced dramatically during storage. However, after the initial loss of nitrite following addition, the residual nitrite values remained almost unchanged for the whole storage period at both 0°C and -10°C storage temperatures. These results agree closely with the reports in the literature, as it is known that reactions of nitrite in meat are accelerated by temperature (Nordin, 1969). The residual nitrite content found in the samples analyzed immediately after addition of cure only accounted for 70% of the added nitrite. This initial loss of nitrite has also been reported in the literature (Greenberg 1972; Kolari and Aunan, 1972).

There was a significant correlation between microbial growth and TBA values (r = 0.29**). Micrococci and lactobacilli, the main groups of microorganisms able to grow in cured meat products, are strongly lypolitic and also have the ability to produce peroxides (Nurmi, 1966). Both processes are strongly bound to lipid oxidation in meat products (Cerice <u>et al</u>., 1973). The coefficient of correlation between microbial growth and residual nitrite was also highly significant (r = -0.69**). In this case, it is highly probably that microbial growth relates negatively to the inhibitory effect of nitrite. However, conditions leading to depletion of nitrite are also most favorable for microbial development as both are accelerated by increased temperatures.

The lack of a significant correlation between residual nitrite and TBA values (r = -0.15) is not clear, as it has been stated that nitrite has an inhibitory role on oxidative processes in cured meat (Bard and Townsend, 1971).

Table 4 - Least squares means of residual nitrite content during storage of beef preblends

Storage temperature	3% Salt added			6% Salt added		
	-10°C	0°C	15°C	-10°C	0°C	15°C
Day	Nitrite ppm			Nitrite ppm		
1	42.2[a]	42.2[a]	42.2[a]	43.7[a]	43.7[a]	43.7[a]
2	46.8[a]	45.3[a]	32.0[b]	45.9[a]	41.0[a]	29.3[b]
3	46.5[a]	43.0[a]	19.1[c]	43.4[a]	41.7[a]	23.8[bc]
4	38.7[a]	34.5[b]	13.0[d]	41.5[a]	36.3[a]	18.9[c]

[a,b,c,d] Means with the same suprascript letter in the same column are not significantly different (P>0.5).

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1/ Departamento de Technologia Y Bioquimica de Los Alimentos. Facultad de Veterinaria. Universidad de Cordoba, Spain. Dr. Leon Crespo was sponsored by a post-doctoral grant from the Committee of Cultural Interchange between the United States and Spain and was on official leave from the Spanish Ministerio de Sanidad y Sequridad Social.