FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

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CHEMICAL PRESERVATION OF RENDERER'S RAW MATERIAL

Fresh offal collected by renderers frequently cannot be processed immediately and must be stored for a day or more. The spoilage process, probably due to microbial contamination and endogenous enzymes, begins soon after slaughter and results in the development of objectionable odors and in higher free fatty acid levels in the rendered tallow. Warm weather, as might be anticipated, accelerates the spoilage processes.

Edible by-products of the meat packing industry are necessarily protected from spoilage by observing strict sanitary precautions and refrigerating the materials as quickly as possible after slaughter. For the lower value inedible by-products, however, refrigeration is generally not economically feasible. Pasteurization to inactivate the enzymes and organisms responsible for deterioration is an alternative solution to inhibit the spoilage process. A variety of chemical agents that will delay the deterioration of offal have been reported in the literature.

New Zealand investigators[1,2] studied the effect of temperature on the development of free fatty acids from offal. Storage of offal (cut into pieces roughly 1 x 2 x 3 inches) at 25°C for 10 hours resulted in a rendered tallow not significantly different from freshly rendered offal in both free fatty acid levels and color. Similar results were obtained after storage of the offal at 20°C for 24 hours. Storage of offal for periods longer than 24 hours, however, necessitated refrigeration to prevent an impairment of tallow quality.

These investigators also studied the effect of offal pasteurization on tallow quality and recommended heating to 60°C throughout as quickly as possible. This temperature, when maintained for at least 10 minutes, yielded a rendered tallow equal in quality to that obtained from the rendering of fresh offal. Storage of tallow obtained from pasteurized offal at 60°C for as long as 69 days demonstrated no significant increase in free fatty acid level over that of freshly rendered offal.

Ph control has long been practiced in the fermented meat industry to prolong shelf life, either by deliberate addition of an acid or by inoculation with an acid-generating bacterium. The results of an interesting, though unplanned, chemical preservation study on meat and animal by-products came to light after World War II. A series of experiments on the preservation of animal carcass parts and condemned stock with organic acids was initiated in Berlin in the Fall of 1944.[3,4] Because of wartime exigencies, the investigation had to be interrupted and could not be completed until six years later. Formic acid in a concentration of 4% and a volume of 150-300% of that of the meat product completely prevented spoilage for 45 days at about 50°F and a concentration of 6% formic acid gave protection for no less than six years. Sulfurous acid at 1.5% protected against spoilage for 45 days, but 0.5% sulfurous acid gave evidence of some spoilage.

The Meat Industry Laboratory evaluated sodium sulfite, proprionic acid, acetic acid, glycerol monolaurate, erythorbic acid, citric acid and salt and sorbic acid as preservatives. The preservatives were added to fresh poultry viscera, incubated at 100°F for 48 hours and then the fat was rendered out of the samples and the efficacy of the preservatives was measured by determining the free fatty acid in the rendered fat. These results indicated that the best effect was obtained by the use of the acetic, proprionic and citric acids and salt.

In an effort to expand the Meat Industry Laboratory test and provide insight on this entire subject, Associated Laboratories were contracted by FPRF to investigate this area further. The chemicals evaluated by Associated Laboratories were sodium sulfite, calcium propionate, acetic acid, potassium sorbate, sodium nitrite, phosphoric acid, sodium metabisulfite, formaldehyde and tetracycline HCl. In making these selections, calcium propionate (a mold inhibitor widely used in breads) was substituted for the propionic acid, since the acid has a very disagreeable odor. Potassium sorbate was substituted for the sorbic acid because it is water soluble, whereas the acid is insoluble.

Twenty (20) complete poultry viscera were obtained immediately after slaughtering. The individual viscera (including the heart and liver) were placed in individual plastic bags, refrigerated immediately in crushed ice and transported to the laboratory in ice. Solutions were prepared that contained the various preservatives at concentrations of 0.25% and 1%, with the exception of the antibiotic which was tested at 50, 200 and 500 ppm. Each complete viscera was dipped for 10 minutes in the preservative solution being tested, then drained and incubated at 95°F for 48 hours. At the end of the incubation, the samples were dried in the microwave oven and the fat extracted. The free fatty acid was determined on the extracted fat. The results are given in Table 1.

TABLE 1

Preservative	FFA Extracted Fat	Preservative	FFA Extracted Fat
Sodium Sulfite, 0.25%	57.3%	Phosphoric Acid, 0.25%	42.4%
Sodium Sulfite, 1.0%	55.3%	Phosphoric Acid, 1.0%	26.6%
Calcium Propionate, 0.25%	63.8%	Sodium Metabisulfite, 0.25%	44.8%
Calcium Propionate, 1.0%	41.5%	Sodium Metabisulfite, 1.0%	34.5%
Acetic Acid, 0.25%	38.5%	Formaldehyde, 0.25%	24.5%
Acetic Acid, 1.5%	54.8%	Formaldehyde, 1.0%	16.9%
Potassium Sorbate, 0.25%	32.7%	Tetracycline HCl, 50 ppm	45.9%
Potassium Sorbate, 1.0%	60.0%	Tetracycline HCl, 200 ppm	45.0%
		Tetracycline HCl, 500 ppm	17.3%
Sodium Nitrite, 0.25%	41.7%		
Sodium Nitrite, 1.0%	12.2	Control, Water	53.0%

It is obvious that the decomposition was too extensive for these tests to be meaningful. However, it should be noted that the only tests that showed promise were 1% sodium nitrite, 1% phosphoric acid, 1% formaldehyde and 500 ppm tetracycline.

After studying these data, it was decided that part of the problem lies in the wide variability of the fat content of the viscera. Some of the samples had very small amounts of fat, while some had substantial amounts. It should be noted that the Meat Industry Lab was not able to satisfactorily reproduce their results and they ascribed this to different types of birds used in the subsequent tests. However, it was more likely due to variations in the samples themselves and whether any of the abdominal fat was included in the sample.

Therefore, a new series of tests were carried out in which poultry skins and poultry depot fat were used as a raw material. These were collected from birds sold at retail stands. The tests were conducted as before, dipping the skins or fat in the preservatives for 10 minutes, draining and them incubating for 48 hours at 95°F. At the end of that time, the fat was rendered and the free fatty acid was measured. All of the skins were dipped in 0.25% preservatives (except tetracycline which was 50 ppm & 500 ppm), while the depot fat samples were dipped in the 1% solution. The results are shown in Tables 2 and 3.

TABLE 2

Test With Poultry Skins

Test No.	Preservative	FFA, Rendered Fat
1	Sodium Sulfite, 0.25%	4.95%
3	Calcium Propionate, 0.25%	2.25%
5	Acetic Acid, 0.25%	2.27%
7	Potassium Sorbate, 0.25%	1.55%
9	Sodium Nitrite, 0.25%	1.75%
11	Phosphoric Acid, 0.25%	2.54%
13	Sodium Metabisulfite, 0.25%	0.69%
15	Formaldehyde, 0.25%	1.12%
17	Tetracycline HCl, 50 ppm	0.85%
19	Tetracycline HCl, 500 ppm	0.51%
20	Control	3.82%

TABLE 3

Test With Poultry Fat

Test #	Preservative	FFA, Rendered Fat
2	Sodium Sulfite, 1%	0.48%
4	Calcium Propionate, 1%	0.98%
6	Acetic Acid, 1%	1.68%
8	Potassium Sorbate, 1%	0.78%
10	Sodium Nitrite, 1%	0.52%
14	Sodium Metabisulfite, 1%	0.64%
16	Formaldehyde, 1%	0.11%
18	Tetracycline HCl	0.47%
20	Control	3.82%

While these tests yielded FFA that were more within normal operation conditions, they suffered from the fact that the raw material used was excessively clean. Therefore, a "synthetic" raw material was prepared as follows: whole poultry viscera was blended in a food processor, with 25% of its weight of poultry depot fat, until the material had the consistency of a milk shake. Then the various preservatives being tested were added to 50 gram portions of this mush at the desired level, mixed well and then incubated at 95°F for two days. The fat was then rendered and checked for free fatty acid. The results are given in Table 4.

TABLE 4

Test #	Preservatives	FFA, Rendered Fat
1	Na_2SO_3, 0.25%	30.9%
2	Na_2SO_3, 1%	20.2%

TABLE 4

Test #	Preservatives	FFA Rendered Fat
3	Calcium Propionate, 0.25%	22.4%
4	Calcium Propionate, 1%	21.0%
5	Acetic Acid, 0.25%	31.7%
6	Acetic Acid, 1%	2.4%
7	Potassium Sorbate, 0.25%	21.9%
8	Potassium Sorbate, 1%	24.7%
9	Sodium Nitrite, 0.25%	22.4%
10	Sodium Nitrite, 1%	22.9%
11	H_3PO_4, 0.25%	17.4%
12	H_3PO_4, 1%	1.9%
13	Sodium Metabisulfite, 0.25%	20.1%
14	Sodium Metabisulfite, 1%	5.2%
15	Formaldehyde, 0.25%	12.9%
16	Formaldehyde, 1%	5.8%
17	Tetracycline, 50 ppm	32.3%
18	Tetracycline, 200 ppm	31.9%
19	Tetracycline, 500 ppm	24.4%
20	Control	31.4%
21	Control	32.4%

Conclusion:

First of all, it is apparent that there is no magic ingredient that completely solves the problem of raw material preservation. However, it is also evident that some materials are distinctly useful in retarding spoilage. These fall into three general categories.

In all of the tests that were performed, formaldehyde seemed to be one of the best preservatives. This material volatilizes during the cooking operation and, therefore, leaves no residue. It is commercially available as a 37% solution and is relatively inexpensive. It is also available in some solid forms, such as paraformaldehyde, which will convert back to formaldehyde under the proper conditions. However, it remains to be established whether it would be as effective as the free formaldehyde.

The second category of effective preservatives are acids: such as phosphoric, acetic and citric. Of these phosphoric acid is strongly suggested. It is not only effective, it is reasonably cheap and has the distinct advantage that it ends up in the meat meal as phosphorus. On the other hand, acetic acid is volatile and would corrode the cookers.

Finally, sodium metabisulfite seems to show some promise as a preservative.

All of these chemicals must be added in a significant amount (c. 1%) in order to be effective and they should be added in such a manner as to provide maximum contact with the raw material being preserved.

Chemical preservation of renderers raw materials is not an easy or Utopian process. However it may well be a program worth consideration when unforeseen circumstances result in plant down-time for a number of days during hot weather. It is always best to have an alternative plan ("another oar in the water") for those unforeseen circumstances during these times of high cost of operation.

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References available upon request.