FATS AND PROTEINS
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SALMONELLA DESTROYED BY SOME SIMPLE CHEMICALS

For the past year, researchers at Darling & Company have been searching for non-toxic substances that will inhibit the growth of Salmonella in animal by-product meals. This study has been supported under contract with FPRF by funds from FPRF and NRA. We have just received a final summary report on this project from Mr. Raymond H. Jones, Technical Director, Darling & Company, and the following summary data and statements were prepared from this report.

High moisture levels needed for Salmonella growth. Expeller meat and bone meal was adjusted to different moisture levels, sterilized, inoculated with S. senftenberg and incubated for two weeks at 37°C. The data (Table 1) show that growth (increase in bacterial count) did not occur at moisture levels below 25%. This is much higher than the moisture content of meat and bone meal which indicates that high levels of Salmonella in meat and bone meal must arise from direct contamination and are not the result of growth from a low contamination level.

Table 1. Effect of Moisture Level on Growth of Salmonella in Meat Meal.

% Moisture	Organisms Per Gram			
	24 Hours	72 Hours	120 Hours	Two Weeks
5	10^6	10^6	10^5	10^6
10	10^3	10^3	10^3	10^3
15	10^3	10^3	10^2	10^3
20	10^3	10^3	10^3	10^3
25	10^3	10^5	10^5	10^5
30	10^3	10^6	10^6	10^6
41	10^3	10^8	10^8	10^8

Fats and fatty acids somewhat antagonistic to Salmonella. Slight initial decrease in bacterial count was observed when almost any fat or fatty material was added to defatted meat meal inoculated with Salmonella. This antagonistic effect was more pronounced for fats containing high levels of free fatty acids, and indeed the short chain carboxylic acids completely inhibited Salmonella growth under the test conditions used (Table 2).

Table 2. Influence of Fats and Fatty Acids on Growth of Salmonella on Different Media. (Results are expressed as percent inhibition of growth).

Material	% Growth Inhibition
Bleachable Fancy Tallow (3.9% FFA)	37.0
Yellow Grease (10% FFA)	37.3
Oleic Acid	39.0
Stearic Acid	34.8
Nonanoic Acid	40.3
Butyric Acid	100.0
Valeric Acid	100.0
Caproic Acid	82.3

Antimicrobial Agents for Salmonella. Forty-five chemicals (including essential oils and antibiotics) were tested at different concentrations as antagonists against a mixed culture (five seratypes) of Salmonella. Although a number of compounds, including formaldehyde, phenol and chloramphenicol, exhibited strong bacteriacidal effects, the most promising results were obtained with short chain fatty acids (acetic, propionic, butyric) and other organic and inorganic acids (lactic, citric, phorphoric). Mixtures of some of the acids appeared to be even more effective. One of the best mixtures, designated as Formula # 69 and consisting of 10% propionic acid, 10% lactic acid, 5% citric acid and 75% water, was tested against Salmonella contaminated meat and bone meal. The results (Table 3) show that all Salmonellae in the meat meal were destroyed by a 5% or higher concentration of Formula # 69.

Table 3. Influence of Formula # 69 on Salmonella Counts In Artifically Contaminated Meat Meal

Concentration of Formula # 69 - %	Salmonella Count Per Gram				
	Initial	24 Hrs.	48 Hrs.	72 Hrs.	1 Week
0 (Control)	1900	1700	1800	2000	2100
1	40	20	30	20	20
3	30	30	20	10	10
5	0	0	0	0	0
10	0	0	0	0	0

These findings are most exciting. Of course much additional work will need to be done before the commercial feasibility of using Formula # 69 or similar acid mixtures can be established. Methods of applying and mixing the solution into the meat meal, the best acid mixture to use, cost (materials alone may cost up to $5.00 per ton), influence of storage on the treated meal, and many other factors will need to be investigated.