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New Applications Seen for Antibiotics in Fungicides, Food Preservers, Bactericides

Antibiotics also show promise as contamination controls in grain alcohol fermentation . . . Oleochemicals expected to assume important chemical position . . . Need for right kind of public education on nutrition

CHICAGO.—The use of antibiotics for the control of blight in plants and fish preservation were among the subjects discussed by the Fermentation Subdivision meeting of the Division of Agricultural and Food Chemistry at the 124th meeting of the AMERICAN CHEMICAL SOCIETY here Sept. 6 to 11. These diverse topics were presented in a program on the nontherapeutic uses of antibiotics.

Louis G. Nickel of the biochemical research laboratories of Chas. Pfizer presented a paper on the effect of antibiotics on plant growth. Since the beginnings of the so-called antibiotic era, the effects of these drugs on plant growth have been the subject of interest and investigation. Early workers in the field generally reported the effects of antibiotics on the growth of plants were inhibitory. However, recent work with much lower levels of antibiotics than the previous reports have often shown a stimulatory effect of traces of antibiotics on the growth of plants. The work reported by Dr. Nickel was directed to an attempt to throw some light on the mechanism of this antibiotic stimulation of plant growth. The experiments were performed with duckweed, a small flowering plant which can be grown under sterile conditions.

Although Dr. Nickel did not claim to answer the question of the mechanism of antibiotic stimulation of plant growth he did report on some new possible mechanisms of the stimulation. Among the hypotheses he presented for mechanism of this stimulation were: action may be due to degradation products formed after the antibiotics are in solution, or secondary properties of the antibiotics. Perhaps the antibiotic action is through detoxification of by-products of

the plant metabolism or they might actually act on the plant cell by increasing the permeability of the cell wall. Another interesting possibility is that the antibiotics might exert a sparing action on synthesis of compounds essential for the internal metabolism of the plant cell.

Aureomycin Ice. H. L. A. Tarr of the Pacific Fisheries Experimental Station reported on the results of tests conducted with the Pacific fishing fleets in which Aureomycin in the ratio of one part per million parts of flake ice lengthened the storage life of the freshly caught fish.

Previous work at the institute had shown that Aureomycin and terramycin were the most effective antibiotics for the preservation of flesh foods.

Dr. Tarr also reported that Aureomycin assisted in the preservation of fish if, shortly after capture, they were immersed in a water solution of the antibiotic and then iced in the usual way.

Streptomycin Spinach. The effects of several antibiotics in extending the life of packaged spinach were reported by Wilson L. Smith, Jr., of the USDA research station at Beltsville.

Spinach and other green leafy vegetables are subject to a fairly rapid decay, soft rot, when packaged and stored at room temperature. Refrigeration merely delays the appearance of the soft rot and once the produce is placed in room temperature following cold storage, decay can develop rapidly.

New chairman-elect of the Division of Agricultural and Food Chemistry is W. O. Lundberg (right), Hormel Institute, who was chairman of two symposia on the chemistry of fats. Seated at the table is D. M. Doty, who was re-elected secretary of the division



In the Beltsville experiments reported by Dr. Smith, spinach was sprayed with water solutions of various antibiotics immediately before packaging in commercial type plastic film bags. Streptomycin was found to be the most effective agent in reducing the decay. Although the results of the experiments were fairly encouraging on the effectiveness and practicability of this method for processing spinach, Dr. Smith reminded the audience that the use of antibiotics in foods has not been approved by the Food and Drug Administration.

Antibiotic Bactericide. What is reputed to be the first report of an effective antibiotic bactericide effective in controlling plant diseases was presented by W. J. Zaumeyer of the USDA's Bureau of Plant Industry.

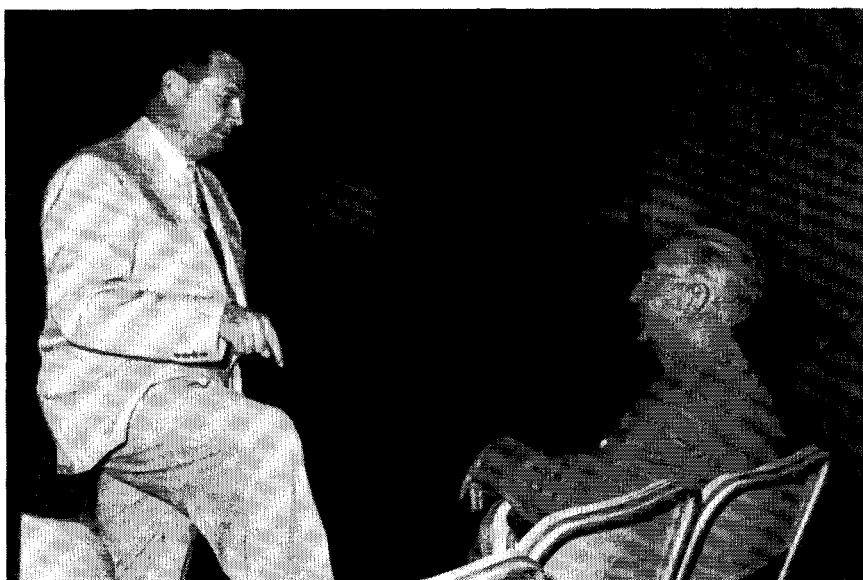
Dr. Zaumeyer reported on experiments in which the effectiveness of streptomycin sulfate was compared with several phenyl mercuric fungicides for the control of the halo blight, a bacterial disease of plants.

The streptomycin spray was found to be more effective than the fungicides and Dr. Zaumeyer believes that in commercial fields which have been lightly infected with halo blight, the disease could be controlled with one or two sprayings of streptomycin, at concentrations as low as 0.025%.

Antibiotics as Contamination Controls In Grain Alcohol Fermentation

Studies of living cells held in continuous culture reveal logarithmic growth. The entrance and development of foreign microorganisms into industrial fermentations cause changes in the fermentation which are variable in nature and in most cases are undesirable, said W. H. Day, Hiram Walker & Sons, Inc., at the Symposium on Fermentation Process Control. Generally speaking, these changes affect the quality of the product, the yield of the product, and the economics of the fermentation process, he added.

Penicillin, Aureomycin, Chloromycetin, terramycin, streptomycin, tyrothricin, and bacitracin as contamination control agents in grain alcohol fermentations were discussed. All exhibited some inhibitory effect on the contaminants characteristic of this fermentation but the various antibiotics varied appreciably in effectiveness. Based upon the amount of antibiotic required, penicillin was found to be the most effective; Aureomycin, bacitracin, Chloromycetin, and terramycin less effective; while tyrothricin and streptomycin were least effective. The beneficial properties exhibited by the antibiotics, particularly penicillin, were the prevention of growth and development of bacteria in fermentation mashes, prevention of the destruction of α -amylase with a reduction in



New chairman of the Pesticides Subdivision, L. G. Cox, United Fruit Co., and new chairman of the Division of Agricultural and Food Chemistry, C. S. Boruff (right) of Hiram-Walker, discuss plans for the coming year

alcohol yield, inhibition of acid production, and the prevention of acrolein production by an isolated *Lactobacillus* 208. Beneficial effects were also noted on the yeast counts in that more viable cells are found in the mashes at the end of fermentation.

The following antibiotic ranges were found effective: penicillin, 0.75 to 2.0 units per milliliter of fermentation mash; Aureomycin, 2.0 to 10.0 micrograms per milliliter; Chloromycetin, 7 to 20 micrograms per milliliter; bacitracin, 10 to 20 micrograms per milliliter; terramycin, 20 to 40 micrograms per milliliter; tyrothricin, 300 to 500 micrograms per milliliter; and streptomycin, little or no effect at the maximum concentration of 1000 micrograms per milliliter.

Population Dynamics. Academic research in the field of bioengineering should bolster applied studies with a more detailed inquiry into the behavior of living cells held in continuous culture, reported Robert E. Wilson, Corn Products Refining Co. As explained by Mr. Wilson, when fermentation is carried out in a cascade of two or more stirred tanks connected in series, the first tank constitutes a propagator. Fresh nutrient is added to the propagator at a constant rate and a constant liquid level is maintained by arranging an overflow at the desired height. The rate of withdrawal is at all times equal to the feed rate. However, this rate is generally so rapid that fermentation within the propagator is not complete, and all nutrients remain in excess of the cell requirements. When operating under such conditions, the cell population is limited solely by the washout of cells.

Bacterium linens grown in a tryptone-yeast extract broth containing 0.5%

glucose exhibited logarithmic growth, as did *Pseudomonas fluorescens* grown in a nutrient broth containing 1% glucose. *Saccharomyces carlbergensis* grown in a nutrient broth with 2% glucose behaved similarly.

When growing yeast in media which were incompletely buffered, a steady cycling in population was observed. The cause for this dynamic instability was traced to steady fluctuations in the pH which were 90° out of phase with fluctuations in population. The phenomenon is of more theoretical than practical interest, but it appears to arise from a servosystem with inherent feedback and finite time delay.

Oleochemicals May Become Important Field

Although fats have been neglected somewhat by the chemists in their search for versatile raw materials, the importance of fat derivatives and the potential they hold is being realized now, according to Daniel Swern of the Eastern Regional Laboratory, USDA. With certain traditional uses of fats falling off, there now is a problem of what to do with these materials. This is causing research chemists to look into their characteristics with more care and interest. As a result, according to Dr. Swern, there are great possibilities for "oleochemicals" and that group of raw materials might assume a position which would give it a place of its own in chemical thinking, much as has happened with petroleum chemicals.

To date, said Dr. Swern, fats which have found uses mostly in the food field have been thought about very little in channels outside their traditional uses and the latter uses have remained predominant. With the exception of glyce-

erol, he pointed out, not many important organic chemicals have been produced from fats.

In enumerating important possible uses for fats and their products, the speaker gave particular attention to the "industrially pure" fatty acids, those which contain more than 90% of a single chemical component. The industrial methods for achieving this purity, he related, are three in number: low-temperature solvent crystallization, selective hydrogenation of the polyunsaturated components of glycerides, and polymerization of the high linoleic fractions followed by distillation of the volatile monomeric acids.

Dr. Swern pointed to a great variety of uses for the pure fatty acids, particularly through their conversion to nitriles, amines, amides, and esters.

A recent use for fats which recently has achieved importance, reported Dr. Swern, is the stabilization of certain resins through the use of epoxidized oils and animal fat esters. These compounds take up the hydrogen chloride given off by decomposition of polyvinyl chloride and thus prevent accelerating degradation of the polymer. The dimer acids from linoleic acid are the base for certain polyamide resins used in coatings. The acetoglycerines made, for example, by the acetylation of mono-glycerides, are finding considerable use in food coating. Azelaic and pelargonic acids now are being manufactured by the splitting of oleic acid, said the speaker. A plant carrying out that reaction is now using the world's largest ozonizer, he said.

Interesterification. A very real potential exists for the industrial application of interesterification, according to L. I. Hansen and N. W. Formo, Archer-Daniels-Midland Co. This process, which involves interchange of the acid radicals of glycerides through hydrolysis and re-esterification, can give, as the ultimate, a statistical orientation of the acid portions of the molecules. It is now possible to unbalance the equilibrium, said Dr. Formo, to give a nonstatistical orientation. This is done either by chilling during the process to solidify certain of the higher melting acid components, or by distilling off the more readily volatile acids as they hydrolyze.

The speaker reported that interesterification now is being used to improve the plasticity of lard. It was used at some periods during the war to make a tung oil-soybean oil combination with particularly desirable film characteristics, but the practicality of that depends heavily on economics. He suggested that interesterification holds good possibilities for the upgrading of drying oils.

Edible Fats. John Cowan, Northern

Regional Laboratory, USDA, in reviewing progress in research on the flavor stability of soybean oil, said that linolenic acid definitely has been shown to be a precursor in the flavor reversion of fatty acids. Other factors may enter, he said, and not all of these are understood.

Dr. Cowan noted that the use of soybean oil for food purposes has increased from 900 million to 1900 million pounds during the past 20 years. There was inference that progress against flavor reversion problems is likely to mean a considerable further increase.

Lipoxidase is a factor to be reckoned with in foods containing unsaturated fatty acids, according to Marian Kies of the National Science Foundation, but that enzyme has a rather limited distribution. It may not be of prime importance in fat deterioration, but it must be taken into consideration in food studies.

Antioxidants. A number of compounds have been studied as antioxidants for fats, it was reported in a review by H. R. Kraybill and L. R. Dugan, Jr., of the American Meat Institute Foundation. Synthetic products have been found to have qualities superior to the natural in carrying through the baking or frying process, he said. There is now an increase in the use of such materials in packages for fats or food containing fats, the speaker said.

A Nutrition Education Foundation

Adult dietary habits are causing the greatest furor that this nation has known over the matter in a generation, declared H. E. Robinson, Swift and Co., before the luncheon of the Division of Agricultural and Food Chemistry.

There can be little doubt, he told the group, that the reducing craze will have a tremendous effect on the per capita intake of foods which are primarily fatty in nature. Furthermore, it now seems possible that the use of potatoes, bread, and cereals crops may drop at an increasing rate in the next year or two.

Dr. Robinson said that all segments of the food industry should be giving attention to this latest of nutrition fads. If properly carried out, he suggested, it could be a wonderful thing. But a strong educational job is needed, it was emphasized, on common sense reducing diets which do not lose nutritional balance through the elimination of certain necessary food elements. In view of the need for the right kind of nutrition education, Dr. Robinson suggested that it might be sound endeavor for the food industry to form a nutritional educational foundation, conducted along the same lines of high policy set by the Nutrition Foundation.



Dr. George D. Scarseth of the American Farm Research Association relates his experiences of limiting factors in agricultural production at the Division of Fertilizer and Soil Chemistry luncheon

Crop Rotations No Longer Necessary, Scarseth Believes

"Agricultural scientists are slow or hesitant to express their more advanced thoughts," said George D. Scarseth of American Farm Research Association, at the Division of Fertilizer and Soil Chemistry luncheon. "We tend to miss the rich margins of a scientist's mind when he publishes only his proved work," he added. According to Dr. Scarseth, the imagination the scientist draws on in speculative thinking before experimenting can be most stimulating to another scientist. He believes that since the agricultural scientific field has such a vast audience of laymen, the agricultural scientist has not been as free to use and express hypotheses and theory as have the astronomer, physicist, and chemist.

"I claim no priority to the hypothesis that I am about to suggest today, but am willing to accept the blame for all," said Dr. Scarseth.

Crop rotations are no longer necessary. This is hardly proved true as yet, but facts point to a hypothesis that says it may work. To illustrate this point he cited the case of the middlewestern farmer who can't afford to grow oats. He does not need them for the straw for bedding or for the legume nurse crop. Other crops can do these tasks more economically. Neither can he afford to grow his old standby, red clover. He can get both nitrogen and organic matter cheaper from synthetic nitrogen and nonlegume higher value crops, if he likes. As a forage crop, alfalfa is better.

Dr. Scarseth has the hypothesis that in fertilizing corn in the North, the greater