with alcoholic oleic acid, such de-fatted starch can be reimpregnated with fatty acid, and this added fat cannot be extracted by hydrocarbon type solvents.

Hence, it appears that free fatty acid is distributed throughout the starch granule as an extraneous impurity. To explain selective extraction, it is suggested that only those fat solvents bearing hydrophilic groups can penetrate into the granule, hydrocarbon types merely washing the surface. This investigation is being continued, and final results will be reported in detail at an early date.

CORN PRODUCTS REFINING COMPANY
EDGEWATER, N. J. THOMAS JOHN SCHOCH

RECEIVED SEPTEMBER 23, 1938

PANTOTHENIC AND NICOTINIC ACIDS AS GROWTH FACTORS FOR LACTIC ACID BACTERIA

Sir:

In a previous publication the preparation of highly active concentrates (1 unit in 0.5 γ) of an essential growth factor for lactic acid bacteria has been described [Snell, Strong and Peterson, *Biochem. J.*, **31**, 1789 (1937)]. Considerable difficulty has been encountered in attempts to further purify this factor, and a long series of fractionation procedures resulted in only about a two-fold increase in activity (1 unit in 0.20 γ).

Recently, information became available [R. J. Williams, papers presented before the American Chemical Society at Milwaukee, Wisconsin, Sept. 5–9, 1938, and private communications] which revealed a striking similarity between the properties of the above growth factor and pantothenic acid [Williams, *et al.*, THIS JOURNAL, **55**, 2912 (1933)]. Both are water-soluble, nitrogenous, organic, hydroxy acids, easily destroyed by aqueous acids or alkalies, but relatively resistant to the action of light, nitrous acid, bromine, and mild oxidizing agents. Through the kindness of Dr. R. J. Williams it has now been possible to subject two samples of pantothenic acid to our bacterial test. One preparation, A, contained approximately 40%, and the other, B, 83% calcium pantothenate. The following results were obtained on *Lactobacillus casei* as the test organism:

Supplement	γ Added per 10 cc. medium a	b	c	d	Cc. 0.1 *N* acid produced per 10 cc. medium a	b	c	d
Sample A	0.0	0.05	0.1	0.5	0.5	1.4	3.5	7.0
Sample B	.0	.02	.05	.3	.5	1.3	3.3	7.8

These and other tests indicated that sample A contained one unit in approximately 0.13 γ, and that B possessed about twice this activity.

Sample B was further tested on *Bacillus lactis acidi*, *Lactobacillus arabinosus*, *Lactobacillus pentosus*, *Lactobacillus delbrückii*, *Bacillus brassicae*, *Streptococcus lactis*, *Leuconostoc mesenteroides*, and *Propionibacterium pentosaceum*, and proved to be highly active for each organism. All of these organisms had previously been shown to require the growth factor. It appears certain that the active substance in our concentrates is identical with pantothenic acid, and that our best preparation contained approximately 26% pantothenic acid.

In addition to pantothenic acid some lactic acid bacteria seem to require nicotinic acid as well. Six species tested were found to grow very poorly or not at all in an acid-hydrolyzed casein medium containing both riboflavin and pantothenic acid. When small amounts of nicotinic acid were added to this medium, a marked improvement in growth and acid production occurred in some cases.

Organism	γ Nicotinic acid added per 10 cc. medium a	b	c	d	Cc. 0.1 *N* acid produced per 10 cc. medium a	b	c	d
L. casei	0.0	0.1	0.3	0.5	2.2	4.1	5.4	6.6
L. arabinosus	.0	.1	.3	.5	1.7	4.7	...	5.2

From the above data it appears that nicotinic acid is also an essential growth factor for at least two species of lactic acid bacteria.

DEPARTMENT OF BIOCHEMISTRY ESMOND E. SNELL
COLLEGE OF AGRICULTURE FRANK M. STRONG
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RECEIVED SEPTEMBER 24, 1938

ORIENTATION OF HIGH MOLECULAR WEIGHT LINEAR POLYMERS IN UNSTRETCHED FILMS

Sir:

Recent electron diffraction studies by Storks[1] furnish definite evidence that unstretched films of polyethylene sebacate consist of relatively small crystallites which are oriented with their long axes approximately in the plane of the film, and with limited rotation around this axis, "probably due in part to the presence of carbonyl groups along the chain." Further, Storks points out that such films will probably show a preferred orientation until the film thickness exceeds the average chain length; only beyond this point do high molecular weight linear polymers exhibit truly amorphous Debye–Scherrer ring patterns.

(1) Storks, THIS JOURNAL, **60**, 1753 (1938).