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FERMENTATION OF COLLAGEN TO IMPROVE NUTRITIVE QUALITY

Unfortunately, a relatively high proportion of animal by-product meals consists of collagen type protein which is not well-balanced, with respect to essential amino acids. Dr. Jules D. Porsche and Dr. William Brown, under contract with FPRF have been studying the possibility of converting collagen to higher nutritive quality protein by fermentation (see Director's Digest, January, 1969 and July, 1969). The results to date on this project may be summarized as follows.

A particular pseudomonad, designated C-E isolated by Dr. Brown and his associates grows rapidly in a medium containing collagen derived protein as the sole source of carbon and nitrogen. For optimal growth the pH (acidity) must be maintained near the neutral point. This can be accomplished by continuous neutralization during the fermentation, but more effectively by adding a supplementary carbon (energy) source to the medium. Molasses is satisfactory for this. The use of mollases not only aids in pH control but also supplies additional carbon necessary for the most efficient conversion of the nitrogen in collagen to microbial protein.

It was found, also, that the organism could utilize animal fat as a supplemental energy source. Fat at a level of 0.3% to 0.5% with a protein level of 1% in the medium was adequate to maintain a neutral pH and optimal growth.

SP-100, a proprietary heat-hydrolyzed collagen, gave more rapid growth than gelatin when used as a substrate for C-E fermentation.

Table I. Essential Amino Acids in SP-100 and in C-E Cells (Grams Amino Acid/100 Grams Protein)

	SP-100	C-E Cells
Isoleucine	2.1	3.7
Leucine	3.6	7.6
Lysine	4.3	6.9
Methionine	1.3	2.2
Phenylalanine	0.9	3.1
Threonine	2.4	3.7
Tryptophan	.17	Not detd.
Valine	3.1	5.2

The protein of C-E cells grown on a medium containing SP-100 and fat had a much better amino acid profile (from a nutritive standpoint) than the SP-100 (Table 1).

When rats were fed a purified diet containing C-E cells as the sole source of protein there was no evidence of toxicity. The utilization of protein was somewhat low, probably due to indigestibility of the cell wall.

The results show conclusively that bacterial fermentation with C-E cells could be used to upgrade collagen protein. From a practical standpoint, however, many problems still remain to be solved. For many reasons that will not be listed here the process using C-E cells would require a continuous fermentation. This involves a large capital expenditure and a degree of technical process control that would discourage many renderers and meat packers.

Consequently, recent studies have included experiments with organisms of larger cell size that might be more adaptable to a batch fermentation process. An organism of large cell size has been found that will utilize collagen effectively as the sole source of nitrogen and energy. In one preliminary study this organism converted more than 25% of the collagen to cell biomass in 24 hours. Nitrogen balance studies, the utilization of supplementary energy sources and methods of autolyzing the cells must be evaluated before the comparative effectiveness of this organism and C-E can be established.