conducted with reasonable accuracy and precision; it simply means that the stage of our knowledge concerning the determination of the particular vitamins studied has not advanced as far."

In general, except for ascorbic acid in green beans, there was good retention of vitamins on storage of the four products studied for 12 months at 0° F. This also held for samples stored for 11 months at 0° F., plus 1 month at 20° F., except for the 25 to 50% retention of ascorbic acid in green beans and green sweet peas.

There appears to be a critical break point in stability of frozen food products not far above 0° F. with marked adverse effects on color and flavor, in addition to losses of ascorbic acid (*2, 4, 7*). This makes it imperative to avoid temperatures above 0° F. Currently, government agencies and the frozen food industry are working toward this end.

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CORRESPONDENCE

Lysine Content of Cottonseed Meals

SIR: Cottonseed meal, the proteinaceous residue of cottonseed which has been processed for oil, varies widely in its value as a protein supplement for poultry rations. This variation in nutritive value is consistently encountered even when the toxic component, gossypol, is reduced to what generally is accepted as a tolerable level.

Numerous investigators have demonstrated that exposure to heat during processing impairs the nutritive value of proteins. Often the evidence indicates that lysine is affected in some manner.

The determination of lysine by ion exchange procedures shows that autoclaving for 2 hours reduces the lysine content of cottonseed protein approximately 35%, as reported by Conkerton, Martinez, Mann, and Frampton [J. AGR. FOOD CHEM. **5,** 460–3 (1957)]. In chick feeding studies, a similar 2-hour autoclaving period reduced the nutritive value of the cottonseed meal approximately 70%. Additional confirmation of the sensitivity of lysine to destruction, even under normal processing conditions, is reported in this communication.

The commercially produced meals used in this experiment were selected on the basis of protein solubility in dilute aqueous alkali and other chemical tests, to be representative of the extremes in heat-damaged meals encountered in the normal processing of cottonseed in the entire cotton belt. Wherever practicable, cottonseed samples representative of 3- to 4-ton seed lots entering the dehulling machinery were obtained at the oil mills producing the selected meals.

The seed samples were dehulled by hand and extracted at room temperature to remove the oil. Cottonseed meal S 6, 76 was prepared on a pilot-plant scale from prime seed by extraction of the rolled meats at room temperature with petroleum ether, followed by butanone.

The quantitative determinations of lysine were carried out on the hydrochloric acid hydrolyzates of the meal and seed materials by a modification of the Moore and Stein ion exchange procedure.

The data obtained on the cottonseed meals and the method by which they were produced are recorded in Table I. There is a marked variation in the lysine content of commercially produced cottonseed meals. This is significant in the utilization of cottonseed meal as a protein supplement in feeds for nonruminant animals, where the ration is composed, in a large measure, of cereals. In such instances, one function of the protein supplement is to make up the deficiency of lysine. Therefore, a part of the variation in the growth response of animals fed cottonseed meal as a protein supplement may be accounted for on the basis of the variation in the lysine supplied in the rations.

A major portion of the variation in the lysine content of cottonseed meal arises because of lysine destruction during the processing operations, as shown in Table II. Approximately one fifth of the lysine content of the seed may be destroyed in conventional commercial operation.

Cottonseed meals C.M. 13 and C.M. 21 are both screw press meals. C.M. 13 was produced with an oil-cooled screw press operated at maximum capacity during which extremes of temperature and pressure are encountered. The resulting meal was scorched and dark brown in color. Conversely, C.M. 21 was produced with a water-cooled screw press operated at reduced speed and low temperature and pressure. The data taken as a whole, indicate that the quantity of lysine destroyed is dependent upon the severity of the processing, and not upon the type of processing used.

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Table I. Lysine Content of Cottonseed Meals

Cottonseed Meal, Lot Number	Lysine, G./16 G. of Nitrogen	Process
S 6, 76	4.3	Experimental meal
C.M. 6	4.0	Prepress-solvent
C.M. 21	3.9	Screw press
C.M. 45	3.9	Prepress-solvent
C.M. 19	3.9	Solvent extracted
C.M. 36	3.6	Screw press
C.M. 16	3.6	Hydraulic press
C.M. 10	3.4	Prepress-solvent
C.M. 13	3.4	Screw press
C.M. 440	2.3	Screw press

Table II. Lysine Content of Cottonseed and of Meals Produced Therefrom

Cottonseed	Lysine, G./16 G. Nitrogen	Source	Cottonseed Meal	Lysine, G./16 G. Nitrogen	Process
C.S. 21	4.1	Commercial seed	C.M. 21	3.9	Screw press
C.S. 19	4.1	Commercial seed	C.M. 19	3.9	Solvent extracted
C.S. 36	4.2	Commercial seed	C.M. 36	3.6	Screw press
C.S. 10	4.1	Commercial seed	C.M. 10	3.4	Prepress solvent
C.S. 13	4.2	Commercial seed	C.M. 13	3.4	Screw press