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**USE OF EXTRUDED SOY FLOUR  
IN MILK REPLACERS FOR CALVES****D.P. Dawson, J.L. Morrill,<sup>1</sup>  
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**Summary**

Oil-extracted, desolventized soy flour without additional heat treatment was used to prepare protein supplements for calf milk replacers by extrusion processing. Various combinations of temperature, moisture, calcium concentration, sulfur, and acid were used to prepare 32 different products. These products were tested for trypsin inhibitor and antigenic activity and the most promising one was chosen for further testing. This product alone or with supplementary amino acids or amino acids and citric acid was used to provide 70% of the protein in experimental milk replacers. These replacers were compared to an all-milk replacer, using growth and metabolic responses of young Holstein bull calves. The extruded soy protein was inferior to milk protein but calf performance was sufficient to indicate a potential for this kind of product in areas where milk products are prohibitively expensive. Amino acid supplementation of this soy product was not beneficial. Acidification had some benefit in the young (<3 week old) calf, but was not beneficial later.

**Introduction**

In many countries, milk is not produced in adequate amounts to meet the demand for human consumption. Even in areas where it is possible to increase milk production, maximum returns result when milk is used to supply food for humans. Thus, it would be desirable to have a feed containing no milk products for young calves and use all saleable milk products for human food. Milk replacers are available for feeding calves but the best ones use protein and carbohydrate only from milk, and all contain a large amount of milk products. Certain non-milk sources of fat are efficiently used by calves and milk carbohydrate (lactose) is readily and economically available in the United States from dried whey, but milk protein has proved to be especially difficult to replace. Most of the non-milk protein in milk replacers is from soybeans. The economical products usually give poor results and even the more expensive products do not give results as good as milk protein. Many human food products are made using extrusion processing of soy protein. It seemed possible that the increased temperature, high pressure, and large shear forces involved in extrusion processing might destroy trypsin inhibitors and antigenic activity of soybeans and be an economical way to improve their use by calves. This experiment was designed to test that hypothesis by producing many different products and evaluating them, with or without further supplementation, for use in calf milk replacers.

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### Procedures

Oil-extracted, desolventized soy flour was used as the raw material. This flour was processed, with or without various additives in different combinations, in a Wenger X-20 extruder. The additives were calcium chloride, fumaric acid, and organic sulfur. The extruder was operated to provide different temperatures and amounts of steam added in the barrel. The various combinations used resulted in the production of 32 different products. These products were tested for content of trypsin inhibitor and certain soy antigens. One sample had very low trypsin inhibitor activity and no activity for antigens tested and was chosen for further evaluation. Soy flour prepared under the same conditions as this sample was used to supply 70% of the protein in an experimental milk replacer. In two other experimental replacers, this soy flour was supplemented with .7% lysine and .7% methionine or with those amino acids and 1% citric acid. Those replacers were compared to a milk replacer containing all milk protein, using neonatal Holstein bull calves in a growth and nitrogen balance study.

### Results and Discussion

The 32 products produced contained trypsin inhibitor at various concentrations between the original 147 units/mg and zero, and glycinin and  $\beta$ -conglycinin activity from 0 to 85% of the original. The sample chosen contained 1 unit/mg trypsin activity and no activity for antigens tested.

Calves fed the all-milk replacer (control) grew faster throughout the 6 weeks of the experimental period. Calves fed the experimental soy flour without additives lost weight between 1 and 2 weeks of age but during the last 4 weeks gained almost as much as the calves fed the control replacer. Those calves fed experimental soy flour supplemented with amino acids and citric acid gained slightly between 1 and 2 weeks of age but grew at a slower rate than those fed the control or experimental replacer without supplements during the remainder of the experiment. The calves fed experimental milk replacer with amino acids only lost considerable weight from 1 to 2 weeks of age and finished with lowest weight of any group.

Feces of calves on control milk replacer were more liquid during the second week of the experiment than feces from other calves, possibly because the mineral content of the replacer was higher. Other data collected supported the growth data and suggested that, while inferior to milk protein, the experimental soy flour has potential for supplying protein for calf milk replacers in areas where milk proteins are unavailable. Amino acid supplementation was not beneficial but acidification was beneficial during the first 2 weeks of life.