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I.E.O. Abdelgadir

J.L. Morrill

J.A. Stutts

*See next page for additional authors*

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## Abstract

Two trials were conducted to determine the optimum conditions for processing whole soybeans for young calves. In the first trial, laboratory procedures and a nitrogen balance study were used. This information was used to design the second trial in which raw and processed soybeans were evaluated in an 8-wk growth trial using 96 Holstein day-old calves. Starters contained soybean meal (SBM), SBM with added fat, raw soybeans, or soybeans processed at 280, 340, or 375°F in a California Pellet Mill Jet-Sploder. Calves fed the starters containing soybeans processed at 340 consumed more feed, gained faster, had lower fecal scores (less scours), and less mortality.; Dairy Day, 1984, Kansas State University, Manhattan, KS, 1984;



## Keywords

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## Authors

I.E.O. Abdelgadir, J.L. Morrill, J.A. Stutts, and B. Morrill

# EFFECT OF PROCESSING TEMPERATURE ON UTILIZATION OF WHOLE SOYBEANS BY YOUNG CALVES[1]

I. O. Abdelgadir, J. L. Morrill, J. A. Stutts,
M. B. Morrill, D. E. Johnson[2],
and K. C. Behnke[3]

## Summary

Two trials were conducted to determine the optimum conditions for processing whole soybeans for young calves. In the first trial, laboratory procedures and a nitrogen balance study were used. This information was used to design the second trial in which raw and processed soybeans were evaluated in an 8-wk growth trial using 96 Holstein day-old calves. Starters contained soybean meal (SBM), SBM with added fat, raw soybeans, or soybeans processed at 280, 340, or 375°F in a California Pellet Mill Jet-Sploder. Calves fed the starters containing soybeans processed at 340 consumed more feed, gained faster, had lower fecal scores (less scours), and less mortality.

## Introduction

Soybeans have a high protein and energy content. However, raw soybeans contain several anti-nutritional factors, which may lower their feed value, especially for young ruminants and nonruminants. Proper heat treatment will destroy these factors and also will improve protein utilization by ruminants by increasing the amount of protein that escapes degradation in the rumen. These experiments were conducted in an attempt to determine the optimal heat treatment for soybeans to be fed to young calves and to evaluate a particular method for performing this treatment.

## Procedures

In the first trials, soybeans were heat-treated using various combinations of temperature and time. The processed beans then were subjected to various laboratory tests and to metabolism studies to determine the optimum set of processing conditions.

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[1]We acknowledge the help of California Pellet Mill, San Francisco, CA in providing financial assistance and of Simonsen Feeds, Quimby, Iowa for processing some of the soybeans.

[2]Department of Statistics

[3]Department of Grain Science and Industry

Using the information gained earlier, a growth trial was conducted with 96 Holstein calves. They were fed milk until weaning at 5 wk of age and all of one of 6 calf starters (Table 1) they would consume from birth until 8 wk of age. The 6 starters were alike except for the supplementary protein sources which were either SBM, SBM with added fat, raw soybeans, or soybeans processed at 280, 340, or 375°F. A California Pellet Mill Jet-Sploder was used to process the soybeans. Growth rates, amounts of feed consumed, and various measurements of health were recorded.

TABLE 1. Ingredient and chemical composition of starters[a]

| Item | Starters[b] | | | | | |
|---|---|---|---|---|---|---|
| | SBM | SBM + fat | Raw | 280 | 340 | 375 |
| | % | | | | | |
| Ingredients | | | | | | |
| Corn cobs, ground | 9.95 | 9.97 | 9.99 | 10.07 | 10.10 | 10.12 |
| Corn, rolled | 40.23 | 40.32 | 40.39 | 40.72 | 40.87 | 40.95 |
| Oats, rolled | 20.12 | 20.16 | 20.20 | 20.36 | 20.43 | 20.47 |
| Soybean meal | 15.29 | 15.85 | — | — | — | — |
| Animal fat | — | 1.57 | — | — | — | — |
| Soybean, ground, raw | — | — | 19.05 | — | — | — |
| Soybean, ground, 280[c] | — | — | — | 18.39 | — | — |
| Soybean, ground, 340[c] | — | — | — | — | 18.1 | — |
| Soybean, ground, 375[c] | — | — | — | — | — | 17.93 |
| Sorghum grain, rolled | 8.04 | 5.75 | 3.98 | 4.01 | 4.03 | 4.04 |
| Dry molasses | 4.66 | 4.67 | 4.68 | 4.72 | 4.74 | 4.75 |
| Minerals and vitamins | 1.71 | 1.71 | 1.71 | 1.73 | 1.73 | 1.74 |
| Chemical analysis | | | | | | |
| Dry matter | 87.3 | 87.3 | 87.9 | 88.4 | 86.2 | 87.6 |
| Crude protein[d] | 17.2 | 15.5 | 14.3 | 15.6 | 15.4 | 16.6 |
| Ether extract[d] | 3.1 | 3.8 | 6.2 | 7.4 | 5.9 | 6.5 |
| Crude fiber[d] | 8.8 | 7.8 | 9.3 | 7.9 | 6.1 | 8.4 |
| Ash[d] | 4.9 | 7.3 | 5.1 | 5.2 | 4.7 | 4.8 |
| Nitrogen free extract[d] | 66.0 | 65.6 | 65.1 | 63.9 | 67.9 | 63.7 |

[a]As fed basis, except as indicated.

[b]Refers to supplementary protein sources. SBM=soybean meal; Raw=raw soybeans; 280, 340 and 375 = soybeans processed at those temperatures.

[c]Indicates processing temperature.

[d]Dry matter basis.

## Results and Discussion

Results in the earlier trials indicated that the optimum treatment should be setting the Jet-Sploder to produce beans with an exit temperature of 340°F. Therefore, that treatment, a treatment with less heat, and one with more heat were chosen to be evaluated in the growth trial. The results of this trial are in Table 2. Growth rate, feed consumption, and health of calves were improved when the calves were fed starters containing soybeans processed to exit at 340°F. To reach that exit temperature the processing time is about 1 min. These results show that soybeans can be used to supply protein in calf starters, that the soybeans should be heat treated, and recommend the desired conditions for processing those beans. The CPM Jet-Sploder, which is energy-efficient, is satisfactory for processing the beans.

Table 2. Average weekly weight gains, feed consumption, and fecal scores, and mortality in growth study

| Treatment[1] | Weight gain (lb) | Starter consumed (lb) | Fecal score[2] | Mortality[3] |
|---|---|---|---|---|
| 340 | $7.6^{a}$ | $12.8^{a}$ | $1.58^{a}$ | 0 |
| 375 | $6.6^{ab}$ | $12.3^{a}$ | $1.86^{ab}$ | 0 |
| 280 | $5.1^{bc}$ | $9.7^{ab}$ | $1.97^{b}$ | 3 |
| Raw | $4.8^{bc}$ | $9.6^{ab}$ | $2.02^{b}$ | 2 |
| SBM | $4.3^{bc}$ | $8.8^{b}$ | $2.17^{b}$ | 4 |
| SBM + fat | $4.2^{c}$ | $8.4^{b}$ | $2.19^{b}$ | 3 |

[1] Refers to protein source in starter; see Table 1.

[2] 1=normal, 2=moderately soft, 3=semi-fluid, 4=watery.

[3] Number of calves that died.

[abc] Means within column with the same letter are not different ($P<.05$ for gain and fecal score, $P<.07$ for starter consumption).