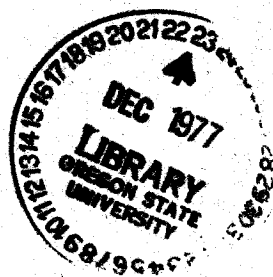
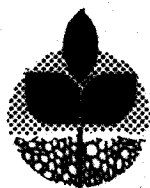


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Special Report 497  
December 1977



Agricultural Experiment Station  
Oregon State University, Corvallis

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**Acknowledgment:** These studies were supported in part by the Oregon State  
Department of Agriculture, Salem, and the Pacific  
Northwest Regional Commission.

# THE FEEDING VALUE OF PACIFIC NORTHWEST GROWN SOYBEANS FOR MARKET TURKEYS

P. L. Paradis, J. A. Harper, H. S. Nakaue and G. H. Arscott

## REVIEW OF LITERATURE

Soybeans are not grown intensively in the Pacific Northwest as they are in the Midwest because of generally unsuitable climatic and soil conditions. However, a few thousand acres of soybeans have been grown successfully in southwestern Washington on irrigated land. Interest in soybeans has been generated because of this venture and because of possible reduction of high freight costs from the Midwest.

Soybean meal is the major source of protein in poultry feeds and Oregon poultry farmers import approximately 60,000 tons of it annually. With the added freight cost (approximately \$43/ton), the poultrymen spend about \$2.5 million annually for this feed. Locally grown soybeans offer a potential savings to poultrymen and consumers.

Effects of feeding raw soybeans to turkeys have been observed to be similar to those seen in other poultry species. Bird *et al.* (1948); Richardson and Blaylock (1950); Saxena *et al.* (1960); Linerode *et al.* (1961a,b) and Griffith *et al.* (1965) all have reported on the detrimental effects of feeding raw soybeans to turkeys: typically depressed growth, reduced feed consumption and feed efficiency and marked pancreatic hypertrophy. Bird *et al.* (1948) and Richardson and Blaylock (1950) reported raw soybean diets supplemented with fish meal improved growth rates over soybean diets. Since fish meal is a good source of methionine, this early work indicated methionine supplementation helped improve raw soybean diets for turkey poults. This was later proved to be true, when Saxena *et al.* (1960) and Linerode *et al.* (1961a,b) showed that diets containing raw soybeans supplemented with methionine were effective in producing good body weight gains in turkey poults. Further work by Behrends and Waibel (1975) showed that the methionine and cystine requirement for turkeys decreases with age. This was thought to be part of the reason why older turkeys can utilize raw soybeans more efficiently.

In recent years, attention has been given to full-fat soybeans in poultry rations because of development of more efficient high energy rations (Rogler and Carrick, 1961). Buescher (1969) pointed out that full-fat soybeans in turkey growing rations have been comparable to conventional rations containing solvent extracted soybeans. Shen *et al.* (1970) fed turkey poults cooked full-fat soybeans and found these diets supported satisfactory growth rates, although not quite as good as weight gains of turkeys fed commercial soybean meal. Moran *et al.* (1973a) supported these findings in their work, showing extruded soybeans were comparable to solvent extracted soybeans in grower rations. However, during the latter stages of the growth period, extruded soybean diets appeared to be poorer. The use of high levels of dietary oils had an adverse effect on finish in terms of softer fat, but these were not found to be objectionable. However, if proportions of the body fat contained too much unsaturated fatty acid the carcass may be less desirable in appearance and cooking quality. Moran *et al.* (1973b) proposed differences in carcass fat content as a factor responsible for differences in eating quality of turkeys because body fat from birds fed extruded soybeans or solvent extracted soybeans with

added oil had a higher degree of unsaturation - and thus a higher drip loss - when the bird was cooked. This was compared to fat from birds fed soybean meal and added animal tallow causing birds to have fat with a lower degree of unsaturation.

## EXPERIMENTAL PROCEDURE

### Turkey Poults

Five hundred and forty Medium White (Wrolstad) turkey poults, hatched at the OSU Turkey Farm, were grown to four weeks of age in this experiment.

The birds were housed in Jamesway battery brooders with wire floors and provided with 24 hours of light daily. Feed, water and insoluble grit were provided ad libitum. Room temperature was started at a minimum of 23°C (73°F) for the first two weeks then reduced to 21°C (70°F).

Nine experimental rations were each fed to four replicate lots of 15 birds each. Each group of 60 birds was fed either a solvent soybean meal (SBM), extruded soybean (ESB) or raw soybean (RSB)\* ration supplemented with or without either 50 g/ton zinc bacitracin (zn bac) or 10 g/ton procaine penicillin (pro pen). These rations are listed in Table 1.

Poults and feed were weighed at four weeks and average body weight (grams) and feed conversion (lbs of feed/lb of bird) calculated. At this time, two poults from each replicate were randomly selected and sacrificed. The pancreata from eight poults per treatment were excised, blotted with paper towel and weighed.

### Results and Discussion

The results of the experiment are presented in Table 2. The poults fed RSB were significantly smaller ( $P < 0.05$ ) and used significantly more ( $P < 0.05$ ) feed per pound of bird than did poults fed SBM or ESB. The observed effects of feeding RSB were in agreement with findings by Bird et al. (1948); Richardson and Blaylock (1950); Saxena et al. (1960); Linerode et al. (1961a,b) and Griffith et al. (1965) who all found raw soybeans inferior to ESB or SBM for supporting growth in young turkeys.

Poults fed ESB were significantly smaller ( $P < 0.05$ ) than those fed SBM. This indicates extruded soybeans still contained some active trypsin inhibitors. This finding also was supported by the significantly larger ( $P < 0.05$ ) pancreata in ESB fed poults compared to SBM fed poults. Birds fed ESB also had significantly reduced ( $P < 0.05$ ) feed conversion as compared to SBM fed birds.

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\*Raw and extruded soybeans were supplied by Oregon State Department of Agriculture and prepared by McDaniel Grain and Feed Company, McMinnville, Oregon.

Table 1. Composition of diets fed turkey poult

| Ingredient                       | SBM  | ESB  | RSB  |
|----------------------------------|------|------|------|
|                                  | %    | %    | %    |
| Corn, yellow                     | 31.0 | 35.0 | 35.0 |
| Soybean meal (44% protein)       | 46.0 | -    | -    |
| Soybean, extruded                | -    | 50.0 | -    |
| Soybean, raw                     | -    | -    | 50.0 |
| Soybean oil                      | 10.0 | -    | -    |
| Filler sand                      | -    | 2.0  | 2.0  |
| Fish meal (70% protein)          | 2.5  | 2.5  | 2.5  |
| Meat and Bone meal (50% protein) | 5.0  | 5.0  | 5.0  |
| Alfalfa meal (17% protein)       | 2.5  | 2.5  | 2.5  |
| Limestone flour                  | 1.0  | 1.0  | 1.0  |
| Defluorinated phosphate          | 1.15 | 1.15 | 1.15 |
| Salt                             | .25  | .25  | .25  |
| Vitamin premix <sup>1</sup>      | .40  | .40  | .40  |
| Trace mineral mix <sup>2</sup>   | .10  | .10  | .10  |
| Coccidiostat <sup>3</sup>        | .05  | .05  | .05  |
| d, l-methionine                  | .05  | .05  | .05  |

Calculated Analyses<sup>4</sup>

|                 |       |       |       |
|-----------------|-------|-------|-------|
| Protein, %      | 28.96 | 26.83 | 26.83 |
| M.E. (kcal/kg)  | 3183  | 3160  | 3160  |
| Calcium, %      | 1.56  | 1.56  | 1.56  |
| Avail. Phos., % | .65   | .65   | .65   |
| Lysine, %       | 1.79  | 1.60  | 1.60  |
| Methionine, %   | .47   | .46   | .46   |
| Met. + Cys., %  | .90   | .90   | .90   |

1. Contributes/kg of ration: vit A, 6608 I.U.; vit D, 2223 I.C.U.; riboflavin, 66 mg; d-pantothenic acid, 11.02 mg; niacin, 44.0 mg; choline, 382 mg; vit B<sub>12</sub>, 11.02 mg; vit E, 2.2 I.U.; vit K, 1.1 mg; folacin, .44 mg.
2. Contributes/kg of ration the following; Ca, 195 mg; Mn, 120 mg; Fe, 40 mg; Cu, 4 mg; I, 2.4 mg; Zn, 55 mg.
3. Amprolium, Merck and Company, Rahway, N.J.
4. These rations were not isocaloric and isonitrogenous since they were hand calculated with a value of 41 percent protein for RSB and ESB. The computer printout of the ration above was different because of a lower programmed whole soybean protein value.

Adding zn bac or pro pen in RSB and SBM rations failed to increase body weights or improve feed conversion. However, zn bac fed with ESB did produce a significantly larger ( $P < 0.05$ ) body weight than the unsupplemented ESB group. Pro pen was not effective with ESB rations for improving body weight.

### Market Turkeys

Three hundred and sixty Large White (Nicholas) male poults were grown from day old to eight weeks of age in 12 pens 2.4 m X 2.7 m (8 ft X 9 ft) with 30 birds per pen. The poults were brooded under Radiant Ray brooders. Temperature was held at 24°C (75°F) with the aid of room heaters for the first two weeks and then lowered to 21°C (70°F) for the next two weeks. After four weeks, the birds received no supplemental heat, and temperature was about ambient at 4° - 18°C (40° - 65°F). The male poults were fed a standard corn and wheat base turkey starter ration until eight weeks of age. Water and feed were supplied ad libitum from automatic waterers and round bulk metal feeders. Artificial light was supplied 24 hours per day from a single 60 watt incandescent lamp for each pen.

Three hundred and sixty female poults of the same hatch and strain were started in three pens 4.9 m X 4.9 m (16 ft X 16 ft) with 120 birds per pen. The poults were brooded under electric hovers with a starting temperature of 35°C (95°F). The temperature was lowered 5°F per week until 21°C (70°F) was reached at the end of the fifth week. These poults received similar light and feed treatment as the males.

At eight weeks of age, the birds were moved into two wire-sided pole houses for initiation of the soybean experiment. The males were placed in one house and the females in another. All birds were randomly assigned to 3 m X 3 m (10 ft X 10 ft) pens with 20 birds per pen. The poults received no supplemental light; the only light available was from natural day length under summer conditions. Feed and water were available ad libitum from bulk feeders and continuous flow waterers. Temperatures in the house were about ambient (4° - 18°C or 40° - 65°F).

Seven experimental rations were fed in three phases (shown in Tables 3, 4 and 5), 8 to 12 weeks; 12 to 16 weeks and 16 to 18 or 16 to 20 weeks. Each ration was fed to replicate groups of 20 males and 20 females. Poults were fed 100 percent SBM, ESB and RSB rations and also combinations of either 1/3 or 2/3 replacement of ESB or RSB with SBM. All rations were balanced isocalorically and isonitrogenously. SBM rations were supplemented with added soybean oil since SBM is lower in energy than either ESB or RSB. ESB and RSB supplied 100 percent of the supplemental protein supplied by SBM. In addition to the seven experimental rations, 20 males and 20 females in replicate lots also were fed three regular OSU turkey grower rations (Table 6).

All birds were weighed at 8, 12 and 16 weeks of age. The females were weighed and marketed at 18 weeks; the males were weighed and marketed at 20 weeks of age. Unused feed was weighed back at these times and feed conversion calculated as pounds of feed per pound of bird. At the end of the experiment, final average body weights and cumulative feed conversions were calculated.

Table 2. Average body weight, feed conversion and pancreatic weights for turkey poults fed solvent soybean meal (SBM) and extruded (ESB) and raw (RSB) full-fat soybeans with and without added zinc bacitracin (zn bac) and procaine penicillin (pro pen) at 4 weeks of age

| Treatment                  | Ave.<br>B.W. <sup>1</sup><br>(gms) | F.C. <sup>2</sup>  | Ave.<br>Pancreatic wt.<br>(gm/100gms B.W.) |
|----------------------------|------------------------------------|--------------------|--|
| SBM                        | 386 <sup>a</sup>                   | 1.24 <sup>f</sup>  | .32 <sup>b</sup>                           |
| SBM + zn bac <sup>3</sup>  | 403 <sup>a</sup>                   | 1.33 <sup>ef</sup> | .38 <sup>b</sup>                           |
| SBM + pro pen <sup>3</sup> | 400 <sup>a</sup>                   | 1.33 <sup>ef</sup> | .36 <sup>b</sup>                           |
| ESB                        | 351 <sup>b</sup>                   | 1.54 <sup>cd</sup> | .57 <sup>a</sup>                           |
| ESB + zn bac <sup>3</sup>  | 386 <sup>a</sup>                   | 1.42 <sup>de</sup> | .54 <sup>a</sup>                           |
| ESB + pro pen <sup>3</sup> | 361 <sup>b</sup>                   | 1.56 <sup>c</sup>  | .53 <sup>a</sup>                           |
| RSB                        | 180 <sup>c</sup>                   | 2.15 <sup>b</sup>  | .57 <sup>a</sup>                           |
| RSB + zn bac <sup>3</sup>  | 180 <sup>c</sup>                   | 2.30 <sup>a</sup>  | .56 <sup>a</sup>                           |
| RSB + pro pen <sup>3</sup> | 201 <sup>c</sup>                   | 2.13 <sup>b</sup>  | .60 <sup>a</sup>                           |

1. Values with differing superscripts are significantly different ( $P \leq 0.05$ ).

2. Average pounds of feed consumed per pound of bird.

3. Zinc bacitracin level; 50 g/t, Procaine penicillin level 10 g/t.

Table 3. Composition of diets fed market turkeys (8-12 weeks)

| Ingredient                          | SBM   | ESB   | 33% SBM-<br>67% ESB | 67% SBM-<br>33% ESB | RSB   | 33% SBM-<br>67% RSB | 67% SBM-<br>33% RSB |
|-------------------------------------|-------|-------|---------------------|---------------------|-------|---------------------|---------------------|
| Corn, yellow                        | 45.0  | 46.0  | 45.5                | 45.5                | 46.0  | 45.5                | 45.5                |
| Soybean meal (44% protein)          | 37.0  | -     | 14.0                | 26.0                | -     | 14.0                | 26.0                |
| Soybean, extruded                   | -     | 45.0  | 28.0                | 13.0                | -     | -                   | -                   |
| Soybean, raw                        | -     | -     | -                   | -                   | 45.0  | 28.0                | 14.0                |
| Soybean oil                         | 9.0   | -     | 3.5                 | 6.5                 | -     | 3.5                 | 6.5                 |
| Alfalfa meal (17% protein)          | 5.0   | 5.0   | 5.0                 | 5.0                 | 5.0   | 5.0                 | 5.0                 |
| Limestone flour                     | 1.35  | 1.35  | 1.35                | 1.35                | 1.35  | 1.35                | 1.35                |
| Defluorinated phosphate             | 1.50  | 1.50  | 1.50                | 1.50                | 1.50  | 1.50                | 1.50                |
| Salt                                | .50   | .50   | .50                 | .50                 | .50   | .50                 | .50                 |
| Vitamin premix <sup>1</sup>         | .30   | .30   | .30                 | .30                 | .30   | .30                 | .30                 |
| Trace mineral mix <sup>2</sup>      | .10   | .10   | .10                 | .10                 | .10   | .10                 | .10                 |
| d, l-methionine                     | .05   | .05   | .05                 | .05                 | .05   | .05                 | .05                 |
| Fermentation Byproduct <sup>3</sup> | .10   | .10   | .10                 | .10                 | .10   | .10                 | .10                 |
| l-Lysine (50%)                      | .10   | .10   | .10                 | .10                 | .10   | .10                 | .10                 |
| Calculated Analyses                 |       |       |                     |                     |       |                     |                     |
| Protein, %                          | 22.18 | 22.09 | 22.12               | 22.03               | 22.09 | 22.13               | 22.03               |
| M.E. (kcal/kg)                      | 3231  | 3218  | 3228                | 3236                | 3218  | 3228                | 3226                |
| Calcium, %                          | 1.21  | 1.21  | 1.21                | 1.21                | 1.21  | 1.21                | 1.21                |
| Avail. Phos., %                     | .39   | .44   | .42                 | .41                 | .43   | .42                 | .41                 |
| Lysine, %                           | 1.28  | 1.24  | 1.26                | 1.26                | 1.24  | 1.26                | 1.26                |
| Methionine, %                       | .36   | .37   | .37                 | .36                 | .37   | .37                 | .36                 |
| Met. + Cys., %                      | .72   | .76   | .75                 | .73                 | .76   | .74                 | .73                 |

1. Contributes/kg of ration the following; vit A, 4976 I.U.; vit D, 1652 I.C.U.; riboflavin, 4.95 mg; d-pantothenic acid, 8.26 mg; niacin, 33.04 mg; choline, 285 mg; vit B<sub>12</sub>, 8.26 mg; vit E, 1.66 I.U.; vit K, .82 mg; folacin, .34 mg.

2. See Table 1 for minerals contributed.

3. Bactofac, Salsbury Laboratories, Charles City, Iowa.



Table 4. Composition of diets fed market turkeys (12-16 weeks)

| Ingredient                           | SBM   | ESB   |       | 33% SBM<br>67% ESB |       | 67% SBM<br>33% ESB |       | RSB   |       | 33% SBM<br>67% RSB |       | 67% SBM<br>33% RSB |       |
|--------------------------------------|-------|-------|-------|--------------------|-------|--------------------|-------|-------|-------|--------------------|-------|--------------------|-------|
|                                      |       |       |       |                    |       |                    |       |       |       |                    |       |                    |       |
| Corn, yellow                         | 55.0  | 55.5  | 55.5  | 55.5               | 55.0  | 55.5               | 55.5  | 55.5  | 55.5  | 55.5               | 55.5  | 55.0               | 55.0  |
| Soybean meal (44% protein)           | 29.0  | -     | -     | 11.0               | 20.7  | 11.0               | -     | -     | 11.0  | 11.0               | 11.0  | 20.7               | 20.7  |
| Soybean, extruded                    | -     | 35.5  | 35.5  | 22.0               | 10.3  | 22.0               | -     | -     | -     | -                  | -     | -                  | -     |
| Soybean raw                          | -     | -     | -     | -                  | -     | -                  | 35.5  | 35.5  | 22.0  | 22.0               | 22.0  | 11.0               | 11.0  |
| Soybean oil                          | 7.0   | -     | -     | 2.5                | 5.0   | 2.5                | -     | -     | 2.5   | 2.5                | 2.5   | 5.0                | 5.0   |
| Alfalfa meal (17% protein)           | 5.0   | 5.0   | 5.0   | 5.0                | 5.0   | 5.0                | 5.0   | 5.0   | 5.0   | 5.0                | 5.0   | 5.0                | 5.0   |
| Limestone flour                      | 1.35  | 1.35  | 1.35  | 1.35               | 1.35  | 1.35               | 1.35  | 1.35  | 1.35  | 1.35               | 1.35  | 1.35               | 1.35  |
| Defluorinated phosphate              | 1.50  | 1.50  | 1.50  | 1.50               | 1.50  | 1.50               | 1.50  | 1.50  | 1.50  | 1.50               | 1.50  | 1.50               | 1.50  |
| Salt                                 | .50   | .50   | .50   | .50                | .50   | .50                | .50   | .50   | .50   | .50                | .50   | .50                | .50   |
| Vitamin premix <sup>1</sup>          | .30   | .30   | .30   | .30                | .30   | .30                | .30   | .30   | .30   | .30                | .30   | .30                | .30   |
| Trace mineral mix <sup>2</sup>       | .10   | .10   | .10   | .10                | .10   | .10                | .10   | .10   | .10   | .10                | .10   | .10                | .10   |
| d, l-methionine                      | .05   | .05   | .05   | .05                | .05   | .05                | .05   | .05   | .05   | .05                | .05   | .05                | .05   |
| Fermentation by-product <sup>3</sup> | .10   | .10   | .10   | .10                | .10   | .10                | .10   | .10   | .10   | .10                | .10   | .10                | .10   |
| l-Lysine (50%)                       | .10   | .10   | .10   | .10                | .10   | .10                | .10   | .10   | .10   | .10                | .10   | .10                | .10   |
| <u>Calculated Analyses</u>           |       |       |       |                    |       |                    |       |       |       |                    |       |                    |       |
| Protein, %                           | 19.34 | 19.33 | 19.34 | 19.34              | 19.38 | 19.33              | 19.33 | 19.34 | 19.34 | 19.34              | 19.38 | 19.38              | 19.38 |
| M.E. (kcal/kg)                       | 3218  | 3210  | 3204  | 3204               | 3216  | 3210               | 3210  | 3204  | 3204  | 3216               | 3216  | 3216               | 3216  |
| Calcium, %                           | 1.19  | 1.19  | 1.19  | 1.19               | 1.19  | 1.19               | 1.19  | 1.19  | 1.19  | 1.19               | 1.19  | 1.19               | 1.19  |
| Avail. Phos., %                      | .39   | .42   | .41   | .41                | .40   | .42                | .42   | .41   | .41   | .41                | .40   | .40                | .40   |
| Lysine, %                            | 1.06  | 1.04  | 1.03  | 1.03               | 1.06  | 1.04               | 1.04  | 1.03  | 1.03  | 1.03               | 1.06  | 1.06               | 1.06  |
| Methionine, %                        | .33   | .34   | .33   | .33                | .34   | .34                | .34   | .34   | .34   | .34                | .34   | .34                | .34   |
| Met. + Cys., %                       | .65   | .69   | .67   | .67                | .66   | .69                | .69   | .67   | .67   | .69                | .66   | .66                | .66   |

1. See Table 3 for vitamins contributed.

2. See Table 1 for minerals contributed.

3. Bactofac, Salsbury Laboratories, Charles City, Iowa.

Table 5. Composition of diets fed market turkeys (16-18 weeks, females; 16-20 weeks, males)

| Ingredient                           | SBM   | ESB   | 33% SBM<br>67% ESB | 67% SB<br>33% ESB | RSB   | 33% SBM<br>67% RSB | 67% SBM<br>33% RSB |
|--------------------------------------|-------|-------|--------------------|-------------------|-------|--------------------|--------------------|
| Corn, yellow                         | 64.3  | 65.0  | 65.0               | 64.8              | 65.0  | 65.0               | 64.5               |
| Soybean meal (44% protein)           | 21.5  | -     | 8.0                | 15.0              | -     | 8.0                | 15.0               |
| Soybean, extruded                    | -     | 26.0  | 16.0               | 7.5               | -     | -                  | -                  |
| Soybean, raw                         | -     | -     | -                  | -                 | 26.0  | 16.0               | 8.0                |
| Soybean oil                          | 5.2   | -     | 2.0                | 3.7               | -     | 2.0                | 3.7                |
| Alfalfa meal (17% protein)           | 5.0   | 5.0   | 5.0                | 5.0               | 5.0   | 5.0                | 5.0                |
| Limestone flour                      | 1.35  | 1.35  | 1.35               | 1.35              | 1.35  | 1.35               | 1.35               |
| Defluorinated phosphate              | 1.50  | 1.50  | 1.50               | 1.50              | 1.50  | 1.50               | 1.50               |
| Salt                                 | .50   | .50   | .50                | .50               | .50   | .50                | .50                |
| Vitamin premix <sup>1</sup>          | .30   | .30   | .30                | .30               | .30   | .30                | .30                |
| Trace mineral mix <sup>2</sup>       | .10   | .10   | .10                | .10               | .10   | .10                | .10                |
| d, l-methionine                      | .05   | .05   | .05                | .05               | .05   | .05                | .05                |
| Fermentation by-product <sup>3</sup> | .10   | .10   | .10                | .10               | .10   | .10                | .10                |
| l-lysine (50%)                       | .10   | .10   | .10                | .10               | .10   | .10                | .10                |
| <u>Calculated Analyses</u>           |       |       |                    |                   |       |                    |                    |
| Protein, %                           | 16.67 | 16.56 | 16.50              | 16.52             | 16.57 | 16.50              | 16.50              |
| M.E. (kcal/kg)                       | 3209  | 3203  | 3208               | 3211              | 3203  | 3208               | 3227               |
| Calcium, %                           | 1.17  | 1.17  | 1.16               | 1.16              | 1.17  | 1.16               | 1.16               |
| Avail. Phos., %                      | .38   | .41   | .40                | .39               | .41   | .40                | .39                |
| Lysine, %                            | .85   | .82   | .83                | .84               | .82   | .83                | .84                |
| Methionine, %                        | .31   | .31   | .31                | .31               | .31   | .31                | .31                |
| Met. + Cys., %                       | .59   | .60   | .60                | .59               | .61   | .60                | .59                |

1. See Table 3 for vitamins contributed.

2. See Table 1 for minerals contributed.

3. Bactofac, Salsbury Laboratories, Charles City, Iowa.

Table 6. Composition of grower diets fed market turkeys<sup>1</sup>

| Ingredients                      | Regular Developer |
|----------------------------------|-------------------|
| Corn, yellow                     | 60.0              |
| Soybean meal (44% protein)       | 20.0              |
| Meat and bone meal (50% protein) | 8.5               |
| Whey, dried                      | 2.5               |
| Alfalfa meal (17% protein)       | 5.0               |
| Limestone flour                  | 1.5               |
| Defluorinated phosphate          | 1.5               |
| Salt                             | .50               |
| Vitamin Premix <sup>2</sup>      | .35               |
| Trace mineral mix <sup>3</sup>   | .05               |
| d, l-methionine                  | .10               |
| <u>Calculated Analyses</u>       |                   |
| Protein, %                       | 20.21             |
| M.E. (kcal/kg)                   | 2790.0            |
| Calcium, %                       | 2.04              |
| Phosphorous, %                   | 1.07              |

1. Feed 9-13 weeks of age, mix 600# corn with 1400# developer = 17% protein for feeding 13-17 weeks of age, mix 1000# corn with 1000# developer = 15% protein for feeding 17-24 weeks of age.
2. Contributes/kg of ration the following: vit A, 5782 I.U.; vit D, 1927 I.C.U.; riboflavin, 5.78 mg; d-pantothenic acid, 9.64 mg; niacin, 38.54 mg; choline, 334 mg; vit B<sub>12</sub>, 9.64 mg; vit E, 1.92 I.U.; vit K, .96 mg; folacin, .38 mg.
3. See Table 1 for minerals contributed.

The viscera of five randomly selected birds from four experimental treatments (100 percent SBM, ESB, RSB and OSU grower) were obtained from the processing plant. Pancreas, proventriculus, gizzard, liver and abdominal fat were excised, blotted with paper towels and weighed. Average weights were determined and expressed as grams of organ per 100 grams body weight.

Adipose tissue and feed samples from each of these four treatments were taken to the Department of Agricultural Chemistry, Oregon State University, for analyses of fatty acids. These samples were extracted using the method of Bligh and Dyer (1959). From these extracts, a small portion of each was methylated by a modification of the procedure of Saddler *et al.* (1966) and analyzed using a Hewlett-Packard model #700 gas chromatograph equipped with dual hydrogen flame detectors. The columns used were 200 feet by 0.03 inch ID wall-coated open tubular columns, coated with ethylene glycol succinate polymer, prepared as described by Lowry and Tinsley (1975). Relative peak areas were calculated by the method of Carroll (1961).

### Results and Discussion

The results of feed conversion and body weight are presented in Tables 7, 8 and 9. The body weights and feed conversion in four-week intervals are presented for males (Table 7) and females (Table 8). There were no significant differences in body weight at any weighing period between birds fed SBM and ESB. However, birds fed RSB gained significantly less ( $P < 0.05$ ) and converted feed to body weight numerically poorer than birds fed either SBM or ESB. However, with both males and females, feed conversion was better during the latter stages of growth for birds fed RSB. This was because as the birds grew older they became more efficient in utilizing raw soybeans. Behrends and Waibel (1975) attribute this observation to the fact that as birds grew older their methionine requirement becomes less critical and protein becomes less important in terms of growth.

In considering the overall results of body weights and feed conversion (Table 9), feeding 100 percent RSB causes a growth retardation and poor feed conversion. However, birds fed either ESB or SBM were not significantly different in body weight. It also is important to note that male birds fed 33 percent RSB did not have significantly smaller body weights than male birds fed either ESB or SBM. This suggests that, under these conditions, RSB can be included in turkey rations at least up to one third of the soybean total without detrimental effects on body weights and feed conversion.

The results of organ weights are presented in Table 10. Feeding RSB caused a marked pancreatic hypertrophy. Birds fed RSB had significantly larger ( $P < 0.05$ ) pancreata, livers and gizzards. There were no other significant differences.

The analyses of feed samples and adipose tissue for fatty acids are presented in Tables 11 and 12. The SBM, ESB and RSB rations had lipids with a higher degree of unsaturation than did OSU grower diets (Table 11). This was because the OSU rations (Table 6) had no added soybean oil while the SBM, ESB and RSB rations had either supplemented oil or high levels of natural oil, respectively. The result indicated that the birds fed OSU grower rations had a higher level of saturated fatty acids as compared to the adipose tissue from birds fed either SBM, ESB or RSB (Table 10). According to Moran *et al.* (1973b)

Table 7. Average body weight and feed conversion for male market turkeys fed solvent soybean meal (SBM), extruded (ESB) and raw (RSB) full-fat soybeans at 12, 16 and 20 weeks of age<sup>1</sup>

| Treatment     | Age (weeks)       |                   |                    |                   |                   |                   |
|---------------|-------------------|-------------------|--------------------|-------------------|-------------------|-------------------|
|               | 12                |                   | 16                 |                   | 20                |                   |
|               | B.W. <sup>2</sup> | F.C. <sup>3</sup> | B.W. <sup>2</sup>  | F.C. <sup>3</sup> | B.W. <sup>2</sup> | F.C. <sup>3</sup> |
| SBM           | 11.8 <sup>a</sup> | 2.29              | 18.7 <sup>a</sup>  | 2.90              | 24.7 <sup>a</sup> | 5.02              |
| ESB           | 11.9 <sup>a</sup> | 2.31              | 18.7 <sup>a</sup>  | 3.09              | 24.7 <sup>a</sup> | 4.70              |
| 33%SBM-67%ESB | 12.2 <sup>a</sup> | 2.38              | 19.1 <sup>a</sup>  | 2.82              | 24.8 <sup>a</sup> | 5.10              |
| 67%SBM-33%ESB | 12.1 <sup>a</sup> | 2.38              | 18.7 <sup>a</sup>  | 2.95              | 24.2 <sup>a</sup> | 5.01              |
| RSB           | 10.5 <sup>a</sup> | 3.15              | 15.2 <sup>c</sup>  | 4.05              | 20.2 <sup>c</sup> | 4.97              |
| 33%SBM-67%RSB | 11.2 <sup>a</sup> | 2.82              | 16.9 <sup>b</sup>  | 3.63              | 22.5 <sup>b</sup> | 4.64              |
| 67%SBM-33%RSB | 11.8 <sup>a</sup> | 2.69              | 18.2 <sup>ab</sup> | 3.48              | 24.1 <sup>a</sup> | 3.94              |

1. Values with differing superscripts are significantly different ( $P \leq 0.05$ ).
2. Average body weight in pounds.
3. Average amount of feed consumed per pound of bird in pounds.

Table 8. Average body weight and feed conversion for female market turkeys fed solvent soybean meal (SBM), and extruded (ESB) and raw (RSB) full-fat soybeans at 12, 16 and 18 weeks of age

| Treatment     | Age (weeks)       |                   |                    |                   |                    |                   |
|---------------|-------------------|-------------------|--------------------|-------------------|--------------------|-------------------|
|               | 12                |                   | 16                 |                   | 18                 |                   |
|               | B.W. <sup>2</sup> | F.C. <sup>3</sup> | B.W. <sup>2</sup>  | F.C. <sup>3</sup> | B.W. <sup>2</sup>  | F.C. <sup>3</sup> |
| SBM           | 9.6 <sup>a</sup>  | 2.54              | 14.1 <sup>ab</sup> | 3.66              | 15.9 <sup>ab</sup> | 4.65              |
| ESB           | 10.0 <sup>a</sup> | 2.49              | 14.6 <sup>a</sup>  | 3.33              | 16.4 <sup>a</sup>  | 4.83              |
| 33%SBM-67%ESB | 10.0 <sup>a</sup> | 2.59              | 14.6 <sup>a</sup>  | 3.10              | 16.5 <sup>a</sup>  | 5.29              |
| 67%SBM-33%ESB | 9.7 <sup>a</sup>  | 2.55              | 14.1 <sup>ab</sup> | 3.22              | 16.1 <sup>ab</sup> | 5.15              |
| RSB           | 8.1 <sup>d</sup>  | 3.73              | 11.9 <sup>d</sup>  | 4.07              | 13.6 <sup>d</sup>  | 4.41              |
| 33%SBM-67%RSB | 8.8 <sup>c</sup>  | 3.11              | 12.8 <sup>c</sup>  | 3.36              | 14.6 <sup>c</sup>  | 4.60              |
| 67%SBM-33%RSB | 9.2 <sup>b</sup>  | 2.82              | 13.6 <sup>b</sup>  | 3.12              | 15.5 <sup>b</sup>  | 5.18              |

1. Values with differing superscripts are significantly different ( $P \leq 0.05$ ).
2. Average body weight in pounds.
3. Average amount of feed consumed per pound of bird in pounds.

Table 9. Average body weight and feed conversion for male and female market turkeys fed solvent soybean meal (SBM), extruded (ESB) and raw (RSB) full-fat soybeans at 18 and 20 weeks<sup>1</sup>

| Treatment     | Body Weight <sup>2</sup> |                   | Feed Conversion <sup>3</sup> |         |
|---------------|--------------------------|-------------------|------------------------------|---------|
|               | Males                    | Females           | Males                        | Females |
| SBM           | 24.7 <sup>a</sup>        | 15.9 <sup>a</sup> | 3.20                         | 3.30    |
| ESB           | 24.7 <sup>a</sup>        | 16.4 <sup>a</sup> | 3.20                         | 3.22    |
| 33%SBM-67%ESB | 24.8 <sup>a</sup>        | 16.5 <sup>a</sup> | 3.29                         | 3.21    |
| 67%SBM-33%ESB | 24.2 <sup>a</sup>        | 16.0 <sup>a</sup> | 3.26                         | 3.23    |
| RSB           | 20.2 <sup>c</sup>        | 13.6 <sup>d</sup> | 4.04                         | 4.06    |
| 33%SBM-67%RSB | 22.5 <sup>b</sup>        | 14.6 <sup>c</sup> | 3.66                         | 3.50    |
| 67%SBM-33%RSB | 24.1 <sup>a</sup>        | 15.5 <sup>b</sup> | 3.35                         | 3.22    |

1. Values with differing superscripts are significantly different ( $P < 0.05$ ).
2. Body weights are the average of two replicate lots of 20 birds each in pounds.
3. Feed conversion in pounds of feed consumed per pound of bird.

Table 10. Average organ weights for male and female turkeys at market age fed solvent soybean meal (SBM), extruded (ESB) and raw (RSB) full-fat soybeans for 10 or 12 weeks

| Treatment      | Grams/100 grams body weight <sup>1</sup> |                    |                   |                   | Abdominal Fat    |
|----------------|--|--------------------|-------------------|-------------------|------------------|
|                | Pancreas                                 | Proven-<br>tricus  | Gizzard           | Liver             |                  |
| <u>Males</u>   |  |                    |                   |                   |                  |
| SBM            | .092 <sup>bc</sup>                       | .129 <sup>b</sup>  | 1.23 <sup>b</sup> | .90 <sup>c</sup>  | .39 <sup>a</sup> |
| ESB            | .109 <sup>b</sup>                        | .125 <sup>b</sup>  | 1.45 <sup>b</sup> | .95 <sup>b</sup>  | .42 <sup>a</sup> |
| RSB            | .265 <sup>a</sup>                        | .170 <sup>a</sup>  | 1.83 <sup>a</sup> | 1.14 <sup>a</sup> | .48 <sup>a</sup> |
| OSU grower     | .081 <sup>c</sup>                        | .125 <sup>b</sup>  | 1.25 <sup>b</sup> | 1.17 <sup>a</sup> | .37 <sup>a</sup> |
| <u>Females</u> |  |                    |                   |                   |                  |
| SBM            | .132 <sup>b</sup>                        | .129 <sup>a</sup>  | 1.52 <sup>b</sup> | 1.23 <sup>a</sup> | .84 <sup>a</sup> |
| ESB            | .137 <sup>b</sup>                        | .136 <sup>b</sup>  | 1.43 <sup>b</sup> | 1.19 <sup>a</sup> | .95 <sup>a</sup> |
| RSB            | .277 <sup>a</sup>                        | .149 <sup>a</sup>  | 1.89 <sup>a</sup> | 1.04 <sup>a</sup> | .39 <sup>a</sup> |
| OSU grower     | .134 <sup>b</sup>                        | .146 <sup>ab</sup> | 1.48 <sup>b</sup> | 1.17 <sup>a</sup> | .81 <sup>a</sup> |

1. Values with differing superscripts are significantly different ( $P < 0.05$ ). Market age for females was 18 weeks; for males it was 20 weeks.



Table 11. Analyses of neutral fatty acids in the solvent soybean meal (SBM), extruded (ESB) and raw (RSB) full-fat soybean rations fed male market turkeys from which abdominal fat was taken<sup>1</sup>

| Treatment            | Neutral Lipid composition, % <sup>2</sup> |                  |                   |                    |                    |                   |
|----------------------|---|------------------|-------------------|--------------------|--------------------|-------------------|
|                      | 16:0                                      | 16:1             | 18:0              | 18:1               | 18:2               | 18:3              |
| SBM                  | 10.92 <sup>b</sup>                        | .04 <sup>b</sup> | 3.49 <sup>b</sup> | 21.75 <sup>a</sup> | 57.72 <sup>a</sup> | 5.73 <sup>a</sup> |
| ESB                  | 11.26 <sup>b</sup>                        | 0 <sup>b</sup>   | 3.76 <sup>a</sup> | 22.03 <sup>a</sup> | 56.00 <sup>b</sup> | 6.71 <sup>a</sup> |
| RSB                  | 10.53 <sup>b</sup>                        | 0 <sup>b</sup>   | 3.36 <sup>b</sup> | 20.99 <sup>b</sup> | 57.47 <sup>a</sup> | 7.43 <sup>a</sup> |
| Control <sup>3</sup> | 15.03 <sup>a</sup>                        | .44 <sup>a</sup> | 3.96 <sup>a</sup> | 20.93 <sup>a</sup> | 55.91 <sup>b</sup> | 3.47 <sup>b</sup> |

1. Values with differing superscripts are significantly different ( $P < 0.05$ ).

2. 16:0 = palmitic acid; 16:1 = palmitoleic acid; 18:0 = stearic acid; 18:1 = oleic acid; 18:2 = linoleic acid; 18:3 = linolenic acid.

3. Mainly as a means of comparison, a separate lot of males and females was maintained on a standard grower ration (OSU grower). This ration was not one of the experimental treatments. See Table 6 for composition of this ration.

Table 12. Analyses of neutral fatty acids in abdominal fat from male market turkeys at 20 weeks of age fed solvent soybean meal (SBM), extruded (ESB) and raw (RSB) full-fat soybeans<sup>1</sup>

| Treatment            | Neutral lipid composition, % <sup>2</sup> |                   |                   |                    |                    |                   |
|----------------------|---|-------------------|-------------------|--------------------|--------------------|-------------------|
|                      | 16:0                                      | 16:1              | 18:0              | 18:1               | 18:2               | 18:3              |
| SBM                  | 15.38 <sup>b</sup>                        | .40 <sup>b</sup>  | 6.67 <sup>a</sup> | 22.52 <sup>b</sup> | 50.95 <sup>a</sup> | 4.07 <sup>a</sup> |
| ESB                  | 16.03 <sup>b</sup>                        | .75 <sup>b</sup>  | 7.31 <sup>a</sup> | 22.52 <sup>b</sup> | 48.88 <sup>a</sup> | 4.93 <sup>a</sup> |
| RSB                  | 16.41 <sup>b</sup>                        | 1.11 <sup>b</sup> | 7.69 <sup>a</sup> | 22.29 <sup>b</sup> | 47.04 <sup>a</sup> | 4.45 <sup>a</sup> |
| Control <sup>3</sup> | 27.80 <sup>a</sup>                        | 5.80 <sup>a</sup> | 8.56 <sup>a</sup> | 32.20 <sup>a</sup> | 25.08 <sup>b</sup> | .92 <sup>b</sup>  |

1. Values with differing superscripts are significantly different ( $P < 0.05$ ).

2. 16:0 = palmitic acid; 16:1 = palmitoleic acid; 18:0 = stearic acid; 18:1 = oleic acid, 18:2 = linoleic acid; 18:3 = linolenic acid.

3. Mainly as a means of comparison, a separate lot of males and females were maintained on a standard growing ration (OSU grower). This was not one of the experimental treatments. See Table 6 for the composition of this ration.

birds having a higher level of unsaturated fats (SBM, ESB and RSB fed birds) will be less desirable because of a higher drip loss when cooking. This would imply, in this experiment, that birds fed SBM with supplemental oil, ESB or RSB would be less desirable because of soft fat.

#### SUMMARY

Experiments were conducted to test the feeding value of Pacific Northwest grown soybeans for poults and market turkeys. Poults fed raw soybeans in the ration from 0 to 4 weeks of age weighed significantly less (approximately half) than those provided extruded or solvent soybean meal in diets. There was no beneficial effect from the addition of either 50 g/ton of zinc bacitracin or 10 g/ton of procaine penicillin to any of the three types of soybean rations.

Market turkeys were fed from 8 to 18 or 20 weeks of age using rations with 100 percent solvent soybean meal, extruded soybeans or raw soybeans and also either 1/3 or 2/3 replacement of extruded or raw soybeans with solvent soybeans. The processed soybeans used in this experiment were found satisfactory for supporting acceptable performance when fed to market turkeys. Particularly, extruded soybeans, when properly processed, were found equal in feeding value to solvent extracted soybeans. Feeding raw soybeans caused a marked reduction in body weight and feed conversion as well as pancreatic hypertrophy. However, 1/3 raw soybeans in growing rations did not show growth-retarding effects. Feeding solvent soybean meal with added oil or extruded and raw full-fat soybeans to market turkeys may cause an overabundance of unsaturated fatty acids in adipose (fat) tissue causing carcasses to be less desirable when cooked.

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