the naphthas used. If about a 5 per cent solution of Methyl Alcohol in naphtha is used for extraction, the fines will settle almost immediately. The alcohol dissolves the lime soaps and therefore removes the protective colloid of the suspension and the fines settle out. This method makes it necessary to recover any water distilled off from the system, so that the alcohol which it will contain can be recovered by distillation.

The final requisite for the solvent extraction system was for the plant to be profitable. The profits possible from such a plant are very easily demonstrated. In the beginning of this paper it was pointed out that one-quarter million tons of meat scraps, an animal by-product, with an average fat content of 11.44 per cent, were produced last year in the state of Ohio. For economical and practical reasons, it is most desirable to reduce the fat content to about 3 per cent in the extracted material; the costs for this extraction, including labor, steam, power, depreciation and maintenance, interest on investment and so forth, would be as a figure $4 per ton.

If the one-quarter million tons of meat scraps at 11.44 per cent fat had been extracted to 3 per cent fat, the yield of fat would have been 174 pounds per ton or a total of 43,500,000 pounds. Assuming a value of 6 cents per pound for this fat, the return per ton from the extraction would have been $10.44. The value of the protein has not changed; though the weight of material has been reduced, the protein percentage has risen in proportion. The net profit from the extraction would therefore be the return of $10.44 less $4, cost of extraction, or $6.44 per ton. For the state of Ohio alone, this represents a clear profit of $1,610,000.

The above figures only show the profit available from extraction after the material had been processed with some other means of fat recovery. Had the material been extracted after cooking, eliminating a handling and operating cost, the profits would have been higher.

The material after extraction will not decompose for an almost unlimited time. With high fat contents, a process of fat hydrolysis is going on continually, liberating fatty acids which are very detrimental for animal and poultry feeding, but with low fat contents, this action is inhibited. The fatty acid content, based on the weight of the material, is reduced appreciably on extraction due to the reduction in fat content. It is the fatty acid content that is particularly harmful to animals and poultry. Fat does very little to aid the growth of an animal, so that a low fat and consequent low fatty acid content feed should show beneficial results. Today finds many of the larger feed mills preferring low fat content meat scraps for blending into animal and poultry feed.

The right of existence of solvent extraction for the recovery of fat from animal by-products has been shown. Though handicapped and deterred in the past, it should soon take its rightful place and be in step with progressing industry.

The Nutritive Value Of Soybean Oil Meal Prepared By The Different Methods Of Oil Extraction

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Abstract

This article is primarily a review of the literature pertaining to the subject. Solvent extracted, hydraulic, and expeller soybean oil meals all contain, if properly cooked, protein of high biological value, similar to that of milk protein. Solvent extracted meal has a higher percentage of protein. Since expeller and hydraulic meals contain more oil than solvent extracted soybean oil meal, they naturally have a slightly higher vitamin A and D potency, but the amounts of these vitamins contained in any type of soybean meal or even in the whole soybean are not significant. Levine's assays reveal that solvent process soybean oil meal contains roughly 2.8 I.U. of vitamin B per gram of solids compared to 1.0 I.U. for hydraulic meal. According to results of Cornell experiments, the vitamin G content of soybeans is not materially affected by any of the common methods of processing. Kraybill reports that expeller and hydraulic pressed soybean oils contain more "lecithin" (total phospholipins) than hexane extracted soybean oil. Therefore his results indicate that our domestic solvent extracted meal contains slightly more "lecithin" than expeller meal. "Lecithin" in soybean oil meal may be valuable as an antioxidant to stabilize the vitamin A contained in mixed feeds.

WE have heard much recently about the use of soybean oil meal or its protein in plastics, paper coatings, paper sizing and for glue, and we know there has been an appreciable volume of soy flour used in dog foods and in edible foods such as meat products and baked goods. The outlet through these channels for the residue of the soybean remaining after oil extraction is not to be discounted; but the fact remains that about 95 per cent of the total output of the residue from the soybean processing plants in this country has been in the form of soybean oil meal which is used as a protein supplement in feeds for farm livestock and poultry.

In this country we are now using three methods for extracting oil from the soybean, namely, the hydraulic, the expeller, and the solvent processes. The resulting oils and meals are known according to the method of extraction employed. In addition the hydraulic and expeller meals are frequently spoken of as "Old Process" soybean oil meal and the solvent meal as the "New Process" soybean oil meal. I imgaine that most of you are fairly well acquainted with the machinery and general operations involved in the hydraulic and expeller methods of oil extraction since both methods have been used in this country for many years. However, the first extensive use of the continuous method of solvent extraction in this country dates back only four years, when the Archer-Daniels-Midland Company began processing soybeans in their newly installed unit at Chicago. If you are interested in this development and the many details involved in operating this type of processing equipment, I suggest that you read the article by Schmidt on this subject (1934).

The soybean contains less oil than most oil bearing seeds such as flaxseed, cottonseed and the peanut, and when we apply average prices for its two principal products, soybean oil and soybean oil meal, on the basis of the average yield of each from the same unit quantity of beans, we find that the meal represents a value equal to, if not greater than, the sales value of the oil. In other words, soybean oil meal is not necessarily a by-product of the soybean as is the case with the meals of the flaxseed, cottonseed and peanut. It is evident that in processing soybeans the industry needs to take precaution to manufacture the most nutritious meal possible as well as to extract the largest possible quantity of a high grade oil. A method of processing which cannot be used to produce efficiently both a high grade soybean oil and a high grade soybean oil meal will be definitely handicapped in its operations. When we consider the close interrelationship between the two principal products of the soybean, I think perhaps a group of oil chemists can see some justification for including on its program a paper in which it is intended to present the facts at our disposal regarding the nutritive value of soybean oil meal prepared by the different methods of oil extraction.

Effect Upon Protein

Soybean oil meal is used in feeds for livestock and poultry primarily as a protein supplement to grains and grain by-products, and therefore we shall consider first the effects of the methods of oil extraction on the quantity and quality of the proteins contained in the different kinds of soybean oil meal. In general, if the various protein supplements available on the market are at all comparable insofar as quality is concerned, the buyer will give preference to a supplement that furnishes protein at the least cost per unit of protein. Therefore quantity of protein has some importance in marketing the different kinds of soybean oil meal. In this regard, then, it is of interest to note that when the oil is extracted with the solvent commonly used in this country—that is, commercial hexane —more oil can be removed from the soybean than by the mechanical methods of oil extraction, and consequently the solvent extracted soybean oil meal will contain more protein than the hydraulic and expeller meals. In fact the processors employing the solvent method of oil extraction have found it possible to safely guarantee 44 per cent of protein in their meal, whereas 41 per cent has been the usual guarantee for hydraulic and expeller soybean oil meals.

Although I have discussed first the quantity of protein contained in different kinds of soybean oil meal, I admit that we are most interested in the quality of protein of the different meals. The term "quality" thus used refers to the biological completeness of the protein as measured by the presence and amount of the various essential amino acids and also the assimilability and the availability of these amino acids for use in the animal body. Osborne and Clapp (1907) in their analysis of glycinin, the principal protein of the soybean, found the content of amino acids for this protein to be similar to the values reported for casein, the principal protein of milk. This indicated that the protein of soybeans was of high quality since milk proteins have always been regarded as such. However, when the raw soybean was put to the test of supplying the proper protein to produce growth of animals and to sustain life, it failed miserably. Osborne and Mendel (1917) were the investigators who reported this failure of raw soybeans to support growth, and these workers also demonstrated that the growth promoting properties of raw soybeans were increased to expectation when they were previously cooked. They concluded from their expermients that heating or cooking of the raw soybeans made the bean or ground whole soybean more palatable and the proteins more digestible to the animal. These were evidently the principal reasons for the phenomenal increase in growth promoting properties.

Many interesting developments have taken place since that time. For instance, with the advent of commercial processing of soybeans, research workers began to notice that some lots of soybean oil meal had a high feeding value. Other lots, manufactured by the same process of oil extraction, had as inferior a feeding value, in terms of rapidity and efficiency of gains, as that of raw soybeans. Hayward, Steenbock and Bohstedt (1936) have reviewed all of these developments, and it was these research workers who first experimented with the different processes of oil extraction to determine the optimum amount of heat necessary in each respective process to give the protein of soybean oil meal a high biological value and to determine the cause of this increase in biological value when the optimum amount of heat was used. They found that a most satisfactory soybean oil meal in terms of protein efficiency could be produced by each of the three methods of oil extraction. Some of the principal points of interest in this regard are contained in the following quotation from their first article:

"Raw soy beans were found to contain protein of low nutritive value as determined by the grams of growth per gram of protein eaten. Commercial soybean oil meals such as the expeller meal processed at low temperatures, 105° C., for 2 minutes or the hydraulic meal cooked at 82° C. for 90 minutes contained proteins similar in nutritive value to the raw soy beans. On the other hand, commercial soy bean oil meals which had been prepared at medium and high temperatures such as expeller meals processed at 112 to 130 and 140 to 150° C. for 2½ minutes or hydraulic meals cooked at 105 and 121° C. for 90 minutes contained proteins which had about twice the nutritive value of the raw soy beans or low temperature meals. These expeller and hydraulic meals prepared at medium temperatures, respectively, were light brown in color while the meals prepared at high temperatures were brown in color. Heating the extracted soy beans at 98° C. for 15 minutes, as in the commercial solvent method of oil extraction, was also found to be an effective method of heat treatment. This solvent meal, however, was light colored. When the ground whole soy bean was autoclaved in the laboratory until the meal was brown in color, the protein had a high nutritive value. These results together with the fact that the commercial solvent meal was found to contain a very efficient protein, suggest that brown color can only be used as an index of the probable efficiency of the proteins of commercial soy bean oil meals produced by the expeller and hydraulic processes."

In their second article Hayward, Steenbock and Bohstedt (1936) conclude on the basis of the results of many feeding tests in which they supplemented the raw soy bean and a properly heated soy bean oil meal with various proteins and with the amino acid 1-cystine, that heating of the soy bean caused such a phenomenal increase in its biological value largely because the heat caused the methionine-cystine fraction of the protein to become available.

It was also at the University of

Wisconsin that Hayward, Halpin, Holmes, Bohstedt and Hart (1937) conducted feeding tests with poultry, using the same lots of the three different kinds of soybean oil meal prepared with known temperature histories as were used in the previously discussed experiments. This work demonstrated the practical application of the previous findings with white rats. When chicks were fed rations containing medium and high temperature hydraulic and expeller soybean oil meals or the ordinary run solvent extracted meal cooked at 98° C. for 15 minutes, substituted for a large part of the usual animal protein such as meat scraps and dried milk, they were practically twice as heavy at eight weeks, with less feed required per unit of gain, as the chicks fed a similar ration containing the raw soybean or low temperature expeller and hydraulic soybean oil meals. In one experiment lasting 20 weeks the high temperature expeller soybean oil meal and the solvent or New Process meal were substituted for all of the animal protein in two identical practical poultry rations. They were fed respectively to two similar lots of chicks. The control lot was fed a ration containing an all animal protein supplement. The lot of chicks receiving the solvent extracted meal surpassed the expeller meal lot in body weight and required less feed per unit of gain. In fact the lot fed solvent extracted meal practically equalled in these respects the control group fed an all animal protein supplement.

While working on this problem at the University of Wisconsin, we learned that certain investigators at Cornell University were desirous of obtaining the different kinds of soybean oil meal produced at different temperatures and of known temperature history. We therefore supplied them with a sufficient amount of all of our soybean materials for their experiments. This work conducted and reported by Wilgus, Norris and Heuser (1936), consisted, as far as the proteins were concerned, of metabolism trials with growing chicks to determine the relative protein efficiency of these materials. They reported the per cent of protein retention on the basis of the values obtained for casein. Their results agree with those of Wisconsin in that the application of higher temperatures in the extraction of oil by the expeller method practically doubles the protein efficiency of raw soybeans and low temperature expeller meals. Their values for the low, medium and high temperature hydraulic meals were very similar, indicating that the longer cooking of 90 minutes even at lower temperatures compensated for the application of higher temperatures in the expeller method since with the expeller method of oil extraction the meal was exposed to this heat for only 2 to 2½ minutes. They obtained the highest protein efficiency with the solvent extracted or New Process soybean oil meal—that is, a value of 92 per cent. The medium temperature hydraulic meal was next with a value of 88 per cent, and then came the high temperature expeller meal with a value of 84 per cent.

These Cornell University investigators concluded from their experiments that soybean oil meals of high protein quality for feeding poultry may be produced by the solvent, hydraulic and expeller processes by the application of a sufficient amount of heat. They also agreed with the workers at the University of Wisconsin that the color and flavor of the meals were not reliable indexes of the feeding value of the meals. In commenting on their results Wilgus, Norris and Heuser (1936) have said as follows: "In the solvent process a low temperature for an even shorter period of time than in the hydraulic method appeared satisfactory for a reason not yet apparent. Possibly the solvent [commercial hexane] exerted some beneficial effect." Incidentally following some of our work at the University of Wisconsin, we had a similar thought regarding the possible effect of the solvent, and our curiosity grew when we viewed the results obtained by Kajizuka (1935). This investigator reported that a soybean powder obtained by extracting soybeans with methyl alcohol had, when fed to albino rats, a higher nutritive value than a soybean powder obtained by extracting soybeans with petroleum benzine. We saw no mention in the review of this work regarding the temperatures that were used in drying these defatted meals.

These various incidents encouraged us to conduct tests in the Biological Laboratory of the Archer-Daniels-Midland Company to determine the effect of different solvents upon the nutritive value of the proteins of soybean oil meal. We took one large lot of soybeans, divided them into smaller portions, and extracted each with one of the following solvents: anhydrous ethyl ether, C.P.; commercial hexane (Skellysolve B); carbon tetrachloride, C.P.; petroleum benzene; and 95% ethyl alcohol. The idea in each case was to prepare each extracted sample of meal with as little heat as possible. The general procedure used in the preparation of all these samples was to grind the beans in corrugated power rolls, using approximately a six pound sample. Each sample was placed in a percolator extractor and sufficient solvent used in each case to cover the total volume of ground meal, and it was then allowed to stand for a period of eight hours. Next the solvent was drawn off and the above operation repeated four times. The meals were then spread out on paper and allowed to dry at room temperature. We fed these extracted meals for a period of 56 days to respective lots of 50-55 gram male white rats, six rats to each lot, at a level to supply about 10 per cent protein in a diet otherwise complete. We also included in this test a control diet with its 10 per cent of protein made up principally of dried milk and other diets containing ground raw soybeans, regular run New Process or solvent extracted soybean oil meal cooked at 98° C. for 15 minutes, and the same regular run solvent meal browned by heating the extracted flakes at 82-105° C. for about 15 minutes. The solvent used in producing this meal was commercial hexane (Skellysolve B). The results of this feeding test are reported below as nutritive value for the respective proteins, which amounts to the grams gain in body weight per gram of protein eaten:

Control (dried milk)	1.73
Raw ground soybeans	0.07
Alcohol extracted soybean oil meal	Negative
Carbon tetrachloride extracted soybean oil meal	0.03
Hexane extracted soybean oil meal	0.02
Ether extracted soybean oil meal	0.24
Benzene extracted soybean oil meal	0.27
Regular run solvent extracted soybean oil meal cooked at 98° C. for 15 minutes	1.36
Browned or toasted New Process soybean oil meal	1.52

These results clearly indicate to us that the solvent itself does not cause any measurable improvement in the nutritive value of the proteins of soybean oil meal. The slightly better showing for the meals extracted with ether and benzene than for the raw soybeans or the meals extracted with the other solvents are interesting and suggest that further work needs to be done on this problem. However, we can readily see from the satisfactory results for the commercial cooked solvent extracted soybean oil meal that heat is indispensable and we cannot hope to produce a highly nutritious soybean oil meal by depending on any of the solvents we have used without the application of proper heat. Incidentally we have little to offer as an explanation for the negative results obtained for our alcohol extracted meal except that the alcohol apparently extracted some essential protein fraction and left the protein still more deficient than in the case of the raw soybean and meals extracted with the various other solvents where the lack of availability of the methionine-cystine fraction appears to be the limiting factor.

All of the results cited so far in this paper showing the nutritive value of the protein in the different kinds of soybean oil meal have been from experiments conducted with white rats and poultry.

The results of our pig feeding experiments at the University of Wisconsin agreed with those previously mentioned for white rats and poultry. We found the raw soybeans and low temperature soybean oil meal to be very unsatisfactory protein supplements to corn, even in combination with 5 per cent of alfalfa and proper minerals. Pigs (initial weight of about 60 pounds) gained only about 0.5 of a pound daily on this combination of feeds; whereas, similar pigs gained from 1.1 to 1.3 pounds daily when the same mixture of feeds contained ordinary run solvent extracted soybean oil meal or medium and high temperature, hydraulic and expeller soybean oil meals. Of course, in these experiments where raw soybeans were fed, we not only experienced slow growth but the usual tendency of soybeans to produce soft pork.

Following these pig feeding experiments with our special soybean oil meal samples, the University of Wisconsin has conducted many tests with the three types of soybean oil meal as found on the market, purchasing their requirements at local elevators. These investigators have concluded that the three types of soybean oil meal are very similar in feeding value for pigs. The University of Minnesota has also conducted a feeding test with the three types of soybean oil meal, and Purdue University has recently compared commercial expeller and solvent soybean oil meal. The results of these experiments have also been similar for the different types of meals used. Several years ago Robison (1930) of the Ohio Agricultural Experiment Station conducted pig feeding experiments with the different kinds of soybean oil meal before the various processors were aware of the importance of heat. He reported a satisfactory feeding value only for an expeller meal which had a brown color and so-called toasted taste. Since that time he has repeated his experiments and confirmed the results of other experiment stations, except for the fact that the workers at the Ohio Agricultural Experiment Station still contend that color is a good index of feeding value; in other words, they fail to find the ordinary run light colored solvent extracted meal satisfactory. The regular run browned or toasted solvent or New Process meal has given satisfactory results in feeding tests during the past three years. This specification can readily be met, without any danger of damaging the oil, by the processors employing the solvent method of oil extraction since the heat necessary to brown the meal is applied to the flakes of oil extraction.

Effect Upon Vitamins

The reports in the literature for the vitamin A contained as carotene in soybeans are very conflicting. Perhaps most of this inconsistency is due to the variation between different varieties. Sherman[1] of the Alabama Polytechnic Institute has informed me that in his analyses of over 50 varieties of soybeans, he found them to range all the way from 10 to 210 gamma of carotene per 100 grams. In terms of vitamin A per gram this would be a range of about 0.16 to 3.5 International or U.S.P. Units.

Since the carotene is closely associated with the oil in the soybean, we would naturally expect to find that expeller and hydraulic soybean oil meals contain less carotene or vitamin A than the whole soybean and we would expect to find the solvent extracted meal to contain still less. This is just about the case according to results which we have available. A couple of years ago a soybean processor was interested in having his soy flour checked with competitive flours for respective vitamin A and D content, and he engaged the Pacini Laboratories, Inc., of Chicago to conduct experiments for this purpose. One of the soy flours assayed was an expeller flour containing about 8 per cent of fat, and another was a solvent extracted flour containing about 3 per cent of fat. The Pacini Laboratories used the standard methods of bioassays for the work and reported values which have for convenience been converted into International Units per gram.

	Vitamin A per Gram	Vitamin D per Gram
Expeller soy flour—8% fat	.36	.165
Solvent extracted soy flour —3% fat	.30	.132

From the data which we have presented on the vitamin A and D content of soybeans and the two soy flours, it appears that a feed manufacturer or farmer would not find it worth his while to depend very much on any one of the three types of soybean oil meal to supply any substantial amounts of these vitamins for livestock and poultry. It is common practice in formulating rations for livestock and poultry to purposely include ingredients which are good carriers of both of these vitamins. I have listed below a few of the common ingredients used with their average vitamin A and D potency per gram and in terms of the approximate potency of Old Process soybean oil meal.

	Vitamin A	Times Greater than Soybean Oil Meal	Vitamin D	Times Greater than Soybean Oil Meal
Standard cod liver oil and fish oils	1000	2777	100	600
Vitamin A and D concentrates and fortified fish oils	3000	8333	400	2400
Alfalfa leaf meal choice green	120	333	...	...
Yellow corn	10	30	...	...

Vitamin B_1: Regarding the vitamin B_1 content of different kinds of soybean oil meals, we are privileged to have the results of recent assays by Levine,[1] Biological Laboratory of the Premier-Pabst Corporation. His results, which he states are only very rough values, are as follows:

Solvent process soybean oil meal —2.8 I.U. per g. of solids.

Hydraulic process soybean oil meal—1.0 I.U. per g. of solids.

The lower value for the hydraulic meal is undoubtedly due to the higher temperature and longer time of processing. Since even higher temperatures are employed in processing soybeans by the expeller

[1]Private communication dated September 28, 1937, from Dr. W. C. Sherman, Alabama Polytechnic Institute, Auburn, Alabama.

[1]Private communication, dated September 27, 1937, from Dr. H. Levine, Premier-Pabst Corporation, Milwaukee, Wisconsin.

method, this type of meal would be expected to have a vitamin B_1 potency similar to that of the hydraulic meal.

Vitamin B_2 or G complex. Levine and Remington (1937) found soybeans of the Beloxi variety to contain 2.4 to 3.2 Bourquin-Sherman rat units of vitamin G per gram. They also found that the vitamin G in soybeans was quite stable to pressure cooking at 15 pounds for 30 minutes. This statement indicates that the vitamin G content of soybeans should not be destroyed to any appreciable degree by the temperatures of oil extraction. Kishlar (1937) has confirmed this supposition by reporting 2½ Bourquin-Sherman rat units of vitamin G per gram for a high grade expeller soybean oil meal. Using chicks for their test animal, Wilgus, Norris and Heuser (1936) of Cornell University assayed the various experimental samples of soybeans and meals which we supplied them from the University of Wisconsin, for the growth promoting factor, vitamin G. In the paper cited they report their results as "Relative Vitamin G Content," but later (Norris, Wilgus, Ringrose, Heinman and Heuser, 1936), these investigators found that the dried pork-liver used as a reference in determining the vitamin G potency of the soybean materials contained approximately 100 micrograms of flavin per gram. In view of this, the reference liver was given a value of 100 chick units of vitamin G per gram, which means that the Cornell University chick unit of vitamin G is approximately equal to 1 microgram of flavin. Therefore I assume that the relative vitamin G values reported by the Cornell University investigators for the various soybean materials can now be read as chick units of vitamin G per gram of material. The values they reported were as follows:

Expeller series: soybeans—2, low temperature meal—2, medium temperature meal—1, and high temperature meal—2.

Hydraulic series: soybeans—3, low temperature meals—2, medium temperature meal—3, and high temperature meal—3.

Solvent series: soybeans—4 and the solvent extracted meal—3. These results indicate that the vitamin G content of soybeans is not affected materially by any of the common methods of processing.

Effect Upon Phospholipins

Following an analysis of many samples of crude expeller, hydraulic and solvent extracted soybean oil, Kraybill (1936) reported that the expeller and hydraulic pressed oils contain more phospholipins, commonly called lecithin, than those extracted by commercial hexane. Since to our knowledge hexane is used in this country for all commercial extraction of soybean oil where the residue is used as a feed for livestock and poultry, Kraybill's results indicate that our domestic solvent extracted soybean oil meals should contain slightly more phospholipins than expeller and hydraulic soybean oil meal. This has been found to be the case by analysis made in the Analytical Laboratory of Archer-Daniels-Midland Company. We used the method outlined by Lebedev and Gryuner (1933) and found that a sample of solvent extracted soybean oil meal contained 1.67 per cent of "lecithin" (total phospholipins) whereas a sample of Old Process soybean oil meal contained 1.62 per cent.

There seems to be considerable confusion in the minds of many people regarding the possible role of phospholipins in the diet of animals. I find little evidence in the literature to indicate that the animal organism will ever suffer from a phospholipin deficiency when the diet contains natural foods and I believe we can go a step further than that by saying that the body can synthesize its own phospholipins when the constituent parts or elements are contained in the animal's diet. Nevertheless, I wish to call your attention to some reports contained in the literature that make me feel that soybean oil meal phospholipins may have a place in mixed feeds in the role of antioxidants to prevent the destruction by oxidation of vitamins, especially vitamin A. Fraps and Kemmerer (1936) of the Texas Agricultural Experiment Station have found that the vitamin A of cod liver oil incorporated in mixed feeds was entirely destroyed in two weeks even when stored at the low temperature of 7 to 9° C. The soybean phospholipins have been credited with considerable antioxygenic properties on certain fats and oils. Olcott and Mattill (1936) review the literature covering these developments and in this paper they include the results of their work showing that it is the cephalin and not the lecithin portion of the commercial soybean preparation known as "lecithin" that is responsible for its antioxygenic properties. I have merely cited for what they may be worth these findings showing that vitamin A in mixed feeds is destroyed undoubtedly by oxidation and that the soybean phospholipins do have antioxygenic properties. If it has not been done, I hope some one will be encouraged to investigate the antioxygenic properties of soybean oil meal.

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