PRESENT AND POTENTIAL MARKETS FOR SAFFLOWER OIL AND MEAL

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PRESENT AND POTENTIAL MARKETS FOR SAFFLOWER OIL

by
Harry O. Doty, Jr. and John V. Lawler[1]

ABSTRACT: The most important use of safflower oil is in food products, particularly margarine and salad and cooking oils. Future demand may depend upon whether consumers, concerned about the possible effect of saturated fat foods on coronary heart disease, prefer the very high unsaturation that safflower oil contributes to food fat products. The only industrial market for safflower oil is drying oil uses and this market is declining because of competition from synthetic resins, especially in latex paint. Safflower oil has the advantage of contributing non-yellowing properties to oil paints, printing ink, etc.

KEY WORDS: Safflower oil, safflower, safflower seed

This article analyzes present and potential U.S. markets for safflower oil and evaluates its competitive position, based partly on a survey of manufacturers in the major end use markets for vegetable oils and oilseed processors in the major safflower producing areas of Arizona and California.[2]

Safflower is one of the oldest cultivated plants. Historically, it has been grown near the Mediterranean Sea and India. Several agricultural experiment stations in the western Great Plains States began research in the 1920's to develop safflower as a U.S. oil crop. Safflower grown in this area was not irrigated and because of low yields, interest in the crop there in the middle and late 1960's was slight. In contrast to this experience in the Great Plains, safflower has had significant success in irrigated areas of California and Arizona since the middle 1950's, and these areas now account for almost all U.S. production.

Safflower seed, 1970

State	Acreage: Planted	Acreage: Harvested	Yield per acre harvested
	Acres	*Acres*	*Pounds*
California	214,000	201,000	1,870
Arizona	11,000	11,000	2,500
	Production	Contract price to grower	Crop value
	Tons	*Dol./ton*	*Thou. dol.*
California	188,000	95	17,860
Arizona	13,800	95	1,311

In 1970 the food use of safflower oil totaled 80 million pounds and industrial use about 20 million.

SAFFLOWER OIL EDIBLE MARKETS

Fats have become an increasingly important source of food energy for Americans. We used almost 11 billion pounds of fats and oils (53 pounds per capita) domestically in foods in 1970 compared with about 7 billion pounds (46 pounds per capita) in 1950. Most of this increase came from greater use of cooking and salad oils and shortening, which in turn reflected the increasing popularity of fried chicken and fish, snack foods, salads, and convenience foods.

Medical research since the 1950's has indicated that a relationship may exist between diets high in saturated fats and heart disease. Of course, other factors, such as overweight, excessive smoking, and hypertension are also known to increase the risk of developing heart disease. The Food and Nutrition Board of the National Academy of Sciences believes that the information developed to date does not justify firm recommendations for radical dietary changes. However, it does believe the necessity of a lower fat diet than the present level, and some substitution of polyunsaturated fat for saturated fat may be indicated. Highly unsaturated vegetable oils have been found to cause large and sustained decreases in plasma cholesterol. Safflower oil, having the highest unsaturation of the commercially available edible oils, would be a logical choice of raw material to replace more saturated fats and oils as the fat component in food products.

Safflower oil's price is usually higher than competitive soybean oil in the major consumption areas. So the extent of the future food use of safflower oil may depend somewhat upon the result of medical research into causes and remedies for coronary heart disease.

The Margarine Industry

Consumption of margarine increased from an annual average of 1.7 billion pounds in 1959-61 (9.3 pounds per capita) to over 2.2 billion pounds in 1970 (11.0 pounds per capita) an annual average growth rate of 2.9%. Margarine is the most important single use for safflower

[1] Agricultural Economists, Economic Research Service.

[2] Safflower meal markets were discussed in *Feed Situation*, May 1971, "Present and Potential Markets for Safflower Meal," by Harry O. Doty, Jr., and John V. Lawler.

oil, utilizing an estimated 22 million pounds in 1970. Safflower oil began to be used in margarine in volume during the early 1960's because of the widespread public interest in polyunsaturated margarine.

Safflower oil's primary technological advantage in making margarine is its greater unsaturation than corn and other edible oils. However, its closest competition in supplying unsaturation to margarine is corn oil. Since the 2 oils both make a high-quality margarine, the competition may center around price, polyunsaturation, and identification by the public. Safflower oil has a definite advantage over corn oil and other edible oils in polyunsaturation.

Fatty acid content of safflower and major competing edible vegetable oils

Oil	Saturated acids	Unsaturated acids	
		Mono-	Poly-
	Percent	*Percent*	*Percent*
Safflower	8-11	10-19	73-79
Corn	12-14	28-32	56-58
Cottonseed	26-31	14-24	50-55
Soybean	10-17	14-35	55-69

Source: John J. Blum, Journal of the American Oil Chemists' Society, Vol. 43, No. 6, June 1966, page 416.

In the early 1970's use of safflower oil in margarine is expected to remain at about the level of recent years, provided current economic and legal factors affecting margarine raw materials remain unchanged. Currently, while there is a ban on advertising which claims the use of polyunsaturated fat will lessen heart attacks, identification or emphasis of the product's polyunsaturation is permitted.

A possible minimum potential market for relatively high unsaturated vegetable oils would be the amount of both corn and safflower oil used in margarine. This quantity has been slightly more than 200 million pounds per year during the last 5 years. If safflower oil's price should become more competitive with soybean oil's price and there were scientific confirmation of the medical benefits of safflower oil in the treatment of coronary heart disease, safflower oil might displace some soybean and other oils in margarine. Corn oil probably could not supply the new demand because it is a byproduct of the corn starch industry and its supply is inelastic.

Prices of selected edible vegetable oils (crude tankcar basis) in 1970 were as follows:

	Cents per lb.
Safflower (N.Y.)	16.3
Corn (Decatur)	16.5
Soybean (Decatur)	12.0
Cottonseed (Valley)	13.4

The Cooking and Salad Oil Industry

Cooking and salad oils, rather than solid or plastic fat, are for functional reasons used in salads, salad dressing products, and for packing various canned fish and meat products. For many kinds of deep fat frying, either a liquid oil or a plastic fat may be used. However, in a large snack-food producing factory, cooking oils may be favored since they can be moved in a piping system without heat and measured volumetrically as well as gravimetrically.

The volume of salad and cooking oils used increased from an annual average of 1.6 billion pounds in 1959-61 (9.0 pounds per capita) to over 3.1 billion pounds in 1970 (15.5 pounds per capita), an average annual growth rate of 7%. The increase has been primarily in soybean oil. The quantity of safflower oil used in this market in 1970 was 12 million pounds.

When safflower oil is used at cooking temperatures some formation of solid (polymeric) particles takes place; the particles adhere to the cooking vessel and influence the flavor of food. Soybean oil and cottonseed are better in this respect. Due to this characteristic and because of its high unsaturation, safflower oil is probably consumed as a salad oil rather than as a cooking oil. Manufacturers and retail distributors (large retail chain stores) of cooking and salad oils indicated that the demand for safflower salad oil has not been large enough for them to incur the additional manufacturing, storage, and marketing expenses which would result from their carrying another salad oil.

The volume of safflower oil used as cooking and salad oil is expected to remain at about the same level as long as the price relationships with other oils continue and the advertising restrictions remain. About 240 million pounds of corn oil have been used per year recently in the salad and cooking oil market. Safflower oil might capture much of the unsaturated salad market if price and legal factors were favorable.

The Shortening Industry

Shortening is a major end-use for vegetable oils. Domestic consumption grew from an annual average of over 2.2 billion pounds in 1959-61 to 3.5 billion pounds in 1970—an average annual growth rate of 4.5%.

Safflower oil use in shortening has been very small, averaging less than 4 million pounds annually in recent years. Safflower oil's relatively high unsaturation causes it to have less stability at baking temperatures than the more saturated fats and oils. When safflower oil is hydrogenated to convert it to a plastic form, the linoleic acid content rapidly decreases and it approaches the saturation content of other hydrogenated vegetable oils such as soybean and cottonseed oil.

In the future probably only small quantities of safflower oil will be used in shortening. The oil has no unique contribution to make as a raw material and there is little public interest in the identification of oils used in baked or deep-fried products.

The Mellorine Industry

Mellorine production is limited because it is prohibited or restricted by the laws of some States. Over two-thirds of the 1969 mellorine production was in Texas (42%) and California (26%). In 1969, mellorine production was about 80% of the ice cream production in Texas and 20% in California.

Safflower oil use in mellorine has 2 technological drawbacks: (1) safflower oil possesses an identifiable flavor, according to some mellorine manufacturers even after it is refined, bleached, and deodorized and (2) use of liquid safflower oil to increase unsaturation in the mellorine, requires greater use of stabilizers than if a partially hydrogenated (more saturated) vegetable oil were used. The quantity of vegetable oils used in mellorine was estimated for 1962-70 to be about 18 to 20 million pounds annually. Cottonseed and soybean oils accounted for about 85%. Other oil constituents include coconut, peanut, corn, and safflower oils. Safflower oil use in mellorine is quite small, probably less than 200,000 pounds annually.

Safflower oil is being used to manufacture small quantities of synthetic and filled milk. Unsaturation will be the most important factor in the potential use of safflower oil in dairy-type products.

High Oleic Safflower Oil

A new kind of safflower seed has been developed with considerably different chemical characteristics in the oil than regular safflower oil. This new oil is currently referred to as high oleic safflower oil. It contains about 80% oleic acid compared to about 13% oleic acid in the regular safflower oil. The linoleic content of high oleic safflower oil is about 12% (compared with 78% for regular safflower oil) and the saturated acids (palmitic and stearic) are about 7%. The iodine value is about 91 compared with about 144 for regular safflower oil and the oxidative stability is 3½ times that of regular safflower oil. High oleic safflower oil would probably find greater use for edible purposes than for industrial purposes such as paint and printing ink, which to a very large degree require a drying oil of relatively high unsaturation.

High oleic safflower oil would probably find primary use as a cooking or frying oil because of its excellent stability and its bland flavor. Olive, peanut, and coconut oils are ones which high oleic safflower oil could most likely displace in cooking or deep-frying.

Peanut oil use as salad and cooking oil (139 million pounds in 1970) may be an easier market for high oleic safflower to enter than the similar olive oil market (62 million pounds in 1970). Imported olive oil has a more distinct flavor than peanut oil and has a cultural tradition among American descendents with a Mediterranean background. To have any significant penetration of this peanut oil market, the price of high oleic safflower oil would have to be close to, if not match the recent price range of peanut oil, 12 to 16 cents a pound, unless significant performance advantages could be demonstrated.

The bland flavor of high oleic safflower oil enables it to be considered for many uses where coconut oil is specified because of its blandness and stability. However, since the unsaturation (or iodine value) of coconut oil is quite low (I.V.=7.5-10.5), it seems unlikely that high oleic safflower oil would be considered for many plasticizer uses of coconut oil. The volume of coconut oil consumed in recent years for all uses varies between 700 and 900 million pounds annually.

High oleic safflower oil might be used for some of the nondrying oil uses of castor oil (lubricants, plasticizers, and hydraulic fluids) since the iodine numbers are about the same (castor oil I.V.=81-91). About 6 to 12 million pounds of castor oil are used annually for these purposes.

The name of high oleic safflower oil might be changed. Under another name this new vegetable oil would be judged on its own merits and not on the advantages and disadvantages associated with regular safflower oil.

SAFFLOWER OIL INDUSTRIAL MARKETS

The annual inedible use of fats and oils is about 5 billion pounds, 26 pounds per capita (one-half of the edible use). A major use is in drying oil products, taking advantage of their "drying" or unsaturation properties. Drying oils in a mixture of solvent, pigment, and sometimes a synthetic resin find most of their use (paint, printing ink, and artists' oil paints) where a thin film is desired on a surface for protection or decoration purposes. There are smaller industrial uses of vegetable oils such as epoxidized plasticizers, calking and putty products, core oil binders, and concrete protection. The drying oil markets have been declining since World War II because of the strong competition from synthetic resins, especially in the form of latex paint.

Safflower oil's only significant use in the industrial market is in drying oil products.

The Paint Industry

The use of vegetable oils in paint formulations is as old as the history of paint and they will remain an important raw material for the paint industry in the foreseeable future despite intense technological and economic competition. Drying oil use in paints and alkyd resins in this country in 1970 was about 620 million pounds, with linseed and soybean oils comprising more than half of the market. Tall, tung, fish, castor and safflower are the other major drying oils.

Safflower oil usage by the paint industry ranged between 10 and 18 million pounds annually in 1964-70, or about 2% of the total drying oils consumed by the paint industry for those years. The use of different types of paints and safflower oil paints in the various paint markets, in 1963, 1966, and estimates for 1972 based on information from industry contacts are shown below.

Percentage distribution of interior, exterior, and industrial paints, by type, 1963, 1966, and 1972 estimate

Type of paint	1963				1966				1972 estimate			
	Trade sales		Ind.	Total	Trade sales		Ind.	Total	Trade sales		Ind.	Total
	Int.	Ext.			Int.	Ext.			Int.	Ext.		
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Oil	10	14	48	72	8	12	45	65	4	6	41	51
Latex	15	5	(1)	20	16	7	1	24	18	14	3	35
Other nonoil	—	—	8	8	—	—	11	11	—	—	14	14
Total	25	19	56	100	24	19	57	100	22	20	58	100
Safflower oil	42	21	37	100	34	34	32	100	33	26	41	100

[1] Less than one percent.

Safflower oil usage in paints is expected to grow from an estimated 18 million pounds in 1966 to 23 million pounds in 1972—a 4.2% average annual growth rate.

Ten technological improvements in safflower oil paints were suggested by paint and resin manufacturers. Six improvements suggested were concerned with some aspect of safflower oil's unsaturation: greater iodine value or more unsaturation, faster drying time, and better film surface hardness and mar resistance. Other suggestions included better non-yellowing, improved shelf life, greater adhesion, and better pigment wetting.

The Printing Ink Industry

Drying oil has been an important raw material for printing ink because of its film-forming ability. Drying oils (especially linseed) have pigment-wetting properties, good transfer qualities, bind firmly to the paper, and impart the necessary drying properties to the ink. Consumption of drying oils in the manufacture of printing inks averaged about 60 million pounds annually in recent years. The pattern of estimated drying oil consumption in printing ink was: linseed oil, 78%; tall oil, 10%; tung oil, 5%; soybean oil, 3%; oiticica oil, 2%; safflower oil, 1%; castor oil (including dehydrated castor oil), 1%. Fish, coconut, and other oils accounted for less than 1%.

The Calking and Glazing Industry

Another use of drying oils is in the manufacture of putty, glazing, and calking compounds. As in the case of paint, printing ink, and artists' oil colors, a vegetable drying oil is mixed with a pigment or pigment-like material. In contrast to the above 3 drying oil products which are applied to a surface in a thin film, putty, glazing, and calking compounds are usually applied in a relatively thick form.

About 60 million pounds of drying oils are estimated to be used annually in putty, and glazing. Soybean oil is the biggest volume vegetable oil, about 45%, linseed oil is about 32%, and tall oil is about 12%. The use of linseed oil has been declining because its use alone results in a hard and brittle putty on aging. Safflower oil accounts for about 6% or 3½ million pounds of the oils used in this market. Fish, dehydrated castor, and tung oils account for about 5%.

The Artists' Oil Paint Industry

Linseed oil has been the dominant drying oil used in artists' oil paints. About 1 to 3 million pounds of drying oils are used annually to make artists' oil paints. Linseed oil probably constitutes about 80% of this market. Safflower, poppyseed, walnut, and soybean oils are also used. In addition, an acrylic latex paint for artists has been developed in the last 10 years. Polymer paint holds perhaps 20% or more of the artists' paint market.

The penetration of safflower oil into the artists' oils market could be improved if the pigment wetting properties of safflower oil were made equal to or superior to those of linseed oil and if its brushability were improved.

The Cosmetic Industry

The cosmetic industry is a potential market for safflower oil because (1) cosmetic formulations frequently contain various vegetable and animal oils, fats, and waxes; (2) the ingredients must be of an edible grade or pure and nontoxic; (3) for some ingredients the cost is not too important if the desired performance or advertising benefit can be obtained.

However, since safflower oil's unsaturation is high, making the cosmetic product unstable, it may not penetrate the cosmetic market. In contrast, high oleic safflower oil might find such use because of its good stability.

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PRESENT AND POTENTIAL MARKETS FOR SAFFLOWER MEAL

BY
Harry O. Doty, Jr., and John V. Lawler[1]

ABSTRACT: Regular safflower meal's major use is in dairy and beef cattle feed in the California-Arizona area where produced. Partially hulled safflower meal is preferred over cottonseed meal for use in laying rations and also finds use in other poultry rations. Future safflower meal demand will have modest growth because of the fewer feeding restrictions it has compared to nonprotein nitrogen and the technological advantages of partially hulled safflower meal over cottonseed meal. Additional markets for safflower hulls need to be developed.

Key Words: Safflower meal, safflower, safflower seed

In recent years, safflower meal production has ranged from about 135 to 305 million pounds (67.5 to 152.5 thousand tons), representing about one-fifth of the product value of safflower seed. Most "regular" safflower meal, a byproduct of safflower seed crushing operations, analyzes between 18 and 24 percent protein, and is usually sold on a 20 percent protein basis. It also contains about 31 percent fiber and 1 percent fat. Sometimes regular safflower meal is processed into range pellets for livestock feeding. Most of the safflower meal is consumed in the California-Arizona area where it is produced because of its bulky nature and the protein feed deficiency of this area.

A relatively new product, high-protein safflower meal, is also commercially available. To produce this product, safflower seed is partially hulled (two-thirds of the hulls removed). Partial hull removal greatly reduces the amount of fiber in the meal, doubles protein content, raises energy level, improves appearance, reduces the breaking up of pellets, and decreases its sponginess. Partially hulled safflower meal contains about 42 percent protein and 15 percent fiber. If more of the hulls were removed, a higher protein safflower meal could be produced. Composition of regular and partially hulled safflower meals, with analyses of cottonseed and soybean meals for comparison, are shown in the table below.

To examine present and potential domestic markets for safflower meal, feed mill operators and meal producers in the major safflower producing areas of California and Arizona were surveyed. Only livestock and poultry feed uses have been considered since edible uses of safflower meal currently are commercially nonexistent.

Safflower meal use by feed mills started as early as 1955. There has been a growing acceptance of safflower meal as a feed ingredient since then. Some large feed manufacturing companies indicated they would have started using it sooner or incorporated it in more kinds of formula feeds had the supply been larger.

Composition of safflower and competing oilseed meals—selected characteristics

Analyses	Safflower meal, regular	Safflower meal, partially hulled
Metabolizable energy (poultry) cal./Kg.	1,160	1,690
	Percent	*Percent*
Protein	22.0	42.0
Fat	1.0	1.3
Fiber	31.0	15.1
T.D.N.[1] (ruminant)	52.0	64.1
Critical amino acids		
Arginine	1.9	3.5
Lysine	.7	1.3
Methionine	.33	.63
Cystine	.35	.67
Tryptophan	.26	.54
Glycine	1.1	2.1
	Cottonseed meal, solvent	**Soybean meal, solvent**
Metabolizable energy (poultry) cal./Kg.	2,024	2,420
	Percent	*Percent*
Protein	41.0	44.0
Fat	3.5	.5
Fiber	13.0	7.0
T.D.N.[1] (ruminant)	72.0	78.0
Critical amino acids		
Arginine	3.6	3.4
Lysine	1.7	2.9
Methionine	.6	.65
Cystine	.8	.67
Tryptophan	.5	.7
Glycine	1.9	2.4

[1] Total digestable nutrients.

Source: Richard D. Allen, Ingredient analysis table, *Feedstuffs, 1970 Yearbook*, page 86.

[1] Agricultural Economists, Economic Research Service.

Safflower Meal Uses

Safflower meal was incorporated by feed mills into a wide variety of feeds, at both high and low percentage levels and for a great diversity of purposes. Regular (20 percent protein) safflower meal was the most widely used safflower meal product. Its greatest use was in dairy cattle feeds where it usually made up about 10 percent of the feed formulation. The level of use ranged from 2½ to 25 percent. Use in beef cattle feed was the second largest use. In beef cattle, calf, and sheep feeds, regular safflower meal was used at levels of 5 to 10 percent. According to some feed formulators, 2 pounds of regular safflower meal can substitute for 1 pound of cottonseed meal and 1 pound of cottonseed hulls in ruminant rations.

Feed mills manufacture several kinds of chicken and turkey feeds with regular safflower meal as an ingredient, and its level of use ranged from 2 to 10 percent. It was used at the higher levels to formulate low lysine feed, primarily chick and turkey starter and pullet grower rations, and at the lower levels in laying rations. It was also used in swine and rabbit feeds.

Partially hulled safflower meal (42 percent protein), while not used as widely by feed manufacturers as regular safflower meal, was being incorporated in chicken and turkey feeds. Partially hulled safflower meal was used as a source of protein in laying rations because it does not contain toxic elements. It most often replaced cottonseed meal and sometimes grape pumice in poultry feeds.

In the safflower meal marketing area of California and Arizona, cottonseed meal was the most widely used high-protein feed ingredient and the one most often replaced by safflower meal in formula feeds. Regular safflower meal most frequently replaced cottonseed meal in dairy and beef cattle rations. Safflower meal with added fat was used to extend or replace copra meal in dairy rations. It also substituted for rice bran, orange pulp, and soybean meal in some dairy rations. In some beef cattle feeds, regular safflower meal replaced barley, milo, soybean meal, and urea in addition to cottonseed meal. In rabbit feed it substituted for alfalfa meal.

Factors Influencing Demand for Safflower Meal

A technological advantage of safflower meal is the absence of gossypol or other toxic or deleterious elements which would limit its use in livestock rations. Laying hens fed cottonseed meal containing gossypol can produce undesirable eggs; upon storage, their whites turn pink and their yolks turn green. Partially hulled safflower meal can be substituted for cottonseed meal in layer rations and thus avoid this problem. Regular safflower meal was not considered competitive with some protein feed ingredients (copra meal, linseed meal, meat meal, feather meal, and fish meal) which are often used for special purposes in a ration. As an ingredient for mixed feeds, regular safflower meal has several physical advantages over some other feed ingredients. It has the desirable characteristics of: flows well, slides out of bins, and handles easily. Safflower meal, if ground properly, makes a better pelleted feed.

Regular safflower meal is used in some rations because of its relatively high fiber content. Turkeys and other animals need some fiber for bulk in their ration, and it is also fed in conjunction with alfalfa hay to prevent the alfalfa from going through the animal's rumen too fast and thus losing some of its nutrient value. Some uses of regular safflower meal hinge on its low lysine content, which enables it to be used in holding rations for chicken and turkey pullets. A relatively low lysine ration serves the useful functions of retarding pullet growth and delaying sexual maturity.

The technological or physical problems associated with the use of regular safflower meal as a feed ingredient were (1) its relatively high fiber content, (2) low energy content, (3) pellets tend to fracture or break up (the coarseness of the grind of some meal causes pellets to fracture), (4) pellet dies wear out more quickly, and (5) poor palatability at high levels of incorporation due to its bitterness (particularly in cattle feeds). This bitterness can be masked by adding molasses, anise, or licorice to the ration. University of California scientists have recommended limiting regular safflower meal to 25 percent of a dairy cattle ration because of the palatability problem. Other criticisms of safflower meal concerned its gray color and low lysine content.

The dominant economic reason for the use of safflower meal was its lower cost of protein in comparison with other available meals. The price of regular safflower meal will need to continue to be half the price (actual or on an amino basis) of cottonseed meal or less for regular safflower meal use in feed to increase substantially. It was also considered a low-cost source of consumable fiber. Regular safflower meal commands a higher price than urea-carbohydrate combinations because it does not have the stringent feeding restrictions of urea.

Economic reasons for not using safflower meal are (1) the prejudice of some dairy farmers against it because of the use of safflower oil in margarine, (2) the availability from only a few oilseed processors, (3) small feed mills limit the number of ingredients used due to their lack of storage facilities, and (4) the high lignin fiber content increases the cost of energy and total digestible nutrients even though its primary purpose in the ration is as a protein source.

Market Potential for Safflower Meal

Demand for safflower meal in the future should increase because of (1) the technological advantages of partially hulled safflower meal over cottonseed meal, and (2) fewer feeding restrictions than for nonprotein nitrogen. Safflower meal demand will increase if less cottonseed meal is available in the California-Arizona area. An increased volume of formula feed sales and a stable price of safflower meal will also increase its demand.

An increasingly important market for relatively low-fiber, high-protein oilseed meal is feed for monogastric animals such as poultry and swine, which cannot utilize nonprotein nitrogen but can tolerate some fiber. Many nutritionists expect the lower cost nonprotein nitrogen products, such as urea, to dominate the protein market in ruminant feeds in the future. This points to the need for developing low-fiber, high-protein safflower meal products, such as partially hulled safflower meal. Several feed manufacturers indicated that in the next few years they expect to increase their use of partially hulled safflower meal.

A partially hulled safflower meal could sell for a half cent per pound ($10 a ton) above cottonseed meal and still increase its market in mixed feeds. The main reservation feedmen had toward boosting usage of partially hulled safflower meal was its availability.

Modifications

The safflower meal property most needing modification is its relatively high fiber content. Possible solutions are to (1) develop improved hulling methods, (2) breed improved thin-hulled varieties, and (3) make nutrients in the fiber available to monogastric animals, for example, through breaking down the cellulosic fiber by chemical reaction, or using enzymes to turn this material into digestible materials, such as sugars.

A second property modification is an increase in the energy content, such as, by adding some fat to the meal. Another improvement needed is a higher protein level, especially protein with a higher lysine content. Feedmen favored removal of the bitter flavor of safflower meal through plant breeding or a debittering process rather than masking it with molasses or flavoring materials as is presently done when it is used at high levels in cattle rations. It was also suggested that regular safflower meal should be ground finer to improve its appearance and make better pellets (less breakage). The removal of most of the hulls from regular safflower meal improves or corrects many of the characteristics of safflower meal to which feedmen object.

Safflower Hull Markets

The hull constitutes a relatively large proportion (40 percent) of the safflower seed. By comparison, hulls are about 25 percent of cottonseed and about 8 percent of soybeans. Hulls of currently grown commercial varieties of safflower seed are extremely tough, high in lignin, and largely undigestible even by ruminant animals. Usually safflower hulls are reground and used as a filler in cattle and horse feeds. On occasions when the protein content of regular safflower meal is above the 20 percent basis on which it is usually sold, processors may market safflower hulls by blending them in with the regular safflower meal.

Processors have at times sold safflower hulls for $10 a ton or more for use as a feed ingredient. At other times, the hulls were difficult to sell and were even given away. Safflower hulls do not make a good bedding material for animals because they are not very absorptive. They also are difficult to burn because of their high silica content (60 to 70 percent).

Since the brightest future of safflower meal appears to lie in raising its protein level, and partial dehulling is one method, the disposal problem of hulls may become greater. Of course, the development of a good thin-hulled commercially grown variety could lessen the problem.

Technological research is needed to discover other uses for safflower hulls. Possible research areas are as (1) a filler in concrete, (2) a decorative construction material, (3) a filler in impregnated pipe, (4) a filler in reinforced plastics, (5) a glue extender, and (6) an abrasive in polishing applications.