Decorticating Linseed and Other Oilseeds

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Abstract

A unique model huller capable of effectively decorticating linseed and other small oilseeds was developed. On linseed, a yield of 25 to 30% of apparently clean hulls was obtainable, but the hulls had an inherently high oil content ranging from 15 to 25%. Altho the oil in hulls has approximately the same iodine number and drying time as the kernel oil, it appears to be characteristic of the hull structure rather than absorbed from the kernel.

Decorticating hempseed with this same huller noticeably improved the oil color, and materially improved the protein content and appearance of the cake.

Good decorticating results were also obtained with this huller on cantaloupe seed, rapeseed, mustard seed, ground nuts, sesame seed, etc.

A mong the well known advantages of decorticating oil seeds before pressing are the following:

1. Increased oil yield — Separation of the non-oil-bearing portion of the seed, or a large part of it, prevents it from absorbing oil up to the amount normally left in cake after pressing. Altho in general practice the percent oil left in cake from decorticated seed is frequently slightly higher than in cake from whole-pressed seed, the actual amount of oil lost in cake per ton of seed is considerably less. Taking cottonseed as an example, a ton of seed gives around 1450 lbs. of cake if whole-pressed, but only around 900 lbs. if decorticated. If the whole pressed cake contains 4.5% oil, and the decorticated seed cake 5%, the corresponding amounts of oil lost in cake are 614 lbs. and 45 lbs. Thus decorticating results in increasing the oil yield about 1% in this case. Separation losses affect this figure slightly, but not enough to materially reduce the advantage of decorticating.

2. Decreased working cost and overhead — The most expensive department of an oil mill is the press room, both as to cost of equipment and labor and other costs. If non-oil-bearing hulls or shells in the amount of say 25% of the seed are separated before the press room, the capacity of the latter will be increased 331/3% with the same equipment, labor, and other costs; that is, the press room handling 100 tons daily of whole-pressed seed will handle 133.3 tons of decorticated seed. The press room costs, and to some extent the overhead of the whole mill, are reduced in direct proportion, less the cost of decorticating and separating, making a substantial net saving.

3. Increased value and marketability of products — For some oilseeds, the quality of oil is better when the seeds are decorticated. For all of them the value and marketability of the cake is increased, due to the higher protein content and improved appearance. The decreased bulk and weight per unit of protein for cake from decorticated seed give it a wider market because of lower shipping costs.

With these definite advantages for decorticating oilseeds, it was desired to determine whether this process could be economically extended to seeds other than those now commonly decorticated, the most important of which are cottonseed, peanuts, sunflower, cocoa beans and tung nuts. A cursory search of the literature revealed no reports of any efforts in this direction; in fact, there is not even any mention of the relative proportion of hull or shell to kernel for such seeds as linseed, hempseed, rapeseed, etc.

LINSEED — Some tests were made on Bombay linseed averaging 7.5% moisture and 43.0% oil content. When cracked by pinching on the edges with forceps the seed could be opened and separated into the hull and a yellowish white kernel, the former being 42.9%, the latter 57.1% of the seed. The inside of the hull was grayish white, and appeared oily under a glass.

Moistening some linseed resulted in softening the hard gum which covers the seed like a varnish, until it swelled up into a slippery, jelly like mass, this being a familiar property of all linseed. As the absorption of water progressed, it became increasingly easy to rub off the hull from the kernel by mild pressure between the fingers in a cloth. This corresponds to the manner in which sesame seed are decorticated for use in the bakery and confectionery industries, and of course other common applications of this principle are well known, such as the thinning of almonds and peanuts.

It was noted that the soft, wet hull tended to separate into two separate "skins," the outer one being quite thin, brownish, and semi-transparent; while the inner one was brownish on the outer side (next to the inner side of the outer skin) and whitish on the inner side, being thicker and more opaque. This separation of the hull into two parts took place more freely as the seed became wetter.

Some humidified seed were passed between a pair of wooden discs 2" wide x 12" dia. running at differential speeds and spaced apart just enough so as to scrape the seed as they passed thru. This "skinned" the seed fairly effectively, and the resulting mass of skins and kernels was separated partly by flotation in salt solution, and partly by handpicking. The hulls and kernels thus separated were dried and analyzed for oil content, showing 1.94% and 69.7% respectively.

When subsequent dry decorticating tests (described hereinafter) gave hulls averaging 20% oil, and kernels 58%, the accuracy of the analyses on these wet-decorticated hulls and kernels was questioned. The apparatus for wet decorticating had already been dismantled, and the test was not repeated; likewise there was no retained sample of the wet-separated hulls on which to check the analysis, altho the calculations of the original analyses were found to be correct. There was a retained sample of the original wet-separated kernels, however, and a check analysis 14 months after the first one showed 68.4% oil. This is a fairly good check, as some oil was probably oxidized in the interval. Thus it seems probable that this method of wet decorticating did separate hulls of low oil content.

It is improbable that wet decorticating would be a practicable or economical process for ordinary oil mill purposes, as the difficulty of separation of hulls and kernels and subsequent cost of drying them would make it impractical. Likewise the humidification might well harm the oil quality by increasing FFA or otherwise. The diffusion of the linseed mucilage or gum through the mass would be a serious obstacle.

The action of acids and alkalies on linseed was next tried, and it was found possible to char off the hull by concentrated sulfuric acid,
or to disintegrate it by strong caustic. The cost of either of these processes, however, would doubtless be prohibitive.

Finally the real object of the tests was achieved by developing a dry decortication process. A model huller was built along unique principles, and this was found to be capable of decorticating the seed fairly effectively, especially after certain preliminary treatment. A rudimentary shaker screen and aspirator were also rigged up to aid in separating the kernels and hulls.

The average results of many tests with this equipment are given in the table of data. It was readily possible to separate 25 to 30% of clean hulls, but their high oil content, ranging from 16 to 25%, was disappointing. This was accompanied by a correspondingly lower oil in kernels, the whole balancing out fairly well with the seed. Thus, assuming 22% av. oil in hulls and 58% in kernels by mechanical separation, and on the basis of 42.9% hulls and 57.1% kernels in seed as shown by hand-cracking and separating, the oil in seed would be 42.5%, as against 43% found by analysis.

Evidently linseed hulls separated by dry decortication, either by hand or by mechanical hulling, are high in oil content. The wide variation in amount of oil found in hulls in various tests with this huller is due to several factors, among them: — The amount of oil absorbed by the hulls varied due to varied length of time the cracked seed mixture stood before the hulls were separated — The varying heat treatment to which the hulls and kernels were subjected in some cases before analysis probably affected the amount of oil extractible, as various investigators have shown. — The samples were imperfectly and variably ground, the hulls usually not being ground at all.

Dr. G. S. Jamieson of the Bureau of Chemistry & Soils, U. S. Dept. of Agriculture, found the iodine numbers and drying times of the oils extracted from the hulls and from the kernels to be practically identical, indicating that the oil content of the hulls may have been absorbed from the kernels. On the other hand, he first washed a batch of the hulls with petroleum ether to determine roughly the amount of "absorbed" oil, finding only 3.1%; subsequent grinding and prolonged extraction of the washed hulls gave 21.8% additional oil, indicating that the major portion of the oil in the hulls is inherent in their structure.

Mr. G. L. Keenan of the Food and Drug Administration, U. S. Dept. of Agriculture, made some microscopical examinations of linseed hulls and kernels supplied by the author, including samples separated by the model huller and others by wet decortication. He found that the hulls from dry decortication appeared to have a layer of the oil-bearing kernel substance adhering to the inner surface; likewise the "inner" skin of the wet decorticated hulls. The "outer skin" of wet decorticated seed showed no such oily material, nor even any absorbed oil. He concluded that the oil in the hulls is due to a part of the oily endosperm of the kernel remaining attached to the hulls. Since one analysis of dry decorticated hulls showed 21.9% protein with 18.8% oil, this conclusion appears to be supported.

It seems probable therefore, that when linseed are decorticated, a certain amount, probably variable, of the endosperm or kernel remains attached to the hull, increasing its weight and oil content. In wet decortication most of the actual woody hull structure separates as an "outer skin" containing no oil; while an "inner skin" consisting mostly of oily endosperm bears a part of the woody hull too. In dry decortication, an integral hull separates with a variable amount of oily endosperm sticking to it. This would help to account for the wide variations observed in oil content of hulls from dry decorticated seed, and would also explain why the quality of the oil in the hulls is the same as that of the kernels, although it is inherent in the hull structure rather than absorbed from the kernel.

Under the circumstances, decortication of linseed for oil mill purposes would hardly be economical. Even if the woody hull alone could be separated without any adhering oily endosperm, probably the amount of it would hardly justify the operation. By observation alone, the inner skin represents considerably more than half the weight of the total hull; in other words, if the woody hull alone could be separated, it would probably be less than 20% of the seed, possibly only 10 to 15%.

MEDICINAL VALUE OF LINSEED HULLS — Boiled linseed (flaxseed tea) is a recognized mild laxative and intestinal demulcent. Since the boiled whole seed pass thru the digestive tract unchanged, their action is obviously due to the soothing, lubricating action of the gum that covers the outside of the seed and becomes very slippery and mucilaginous when wet, rather than to the acknowledged slightly purgative action of linseed oil.

Linseed hulls obtained in the above decortication tests, when freed from oil, were found to have a mild laxative effect when taken in amounts of 1 tablespoonful a day or less. They appear to have the effect of an inert bulk laxative such as wheat bran, plus the lubricative effect of their natural gum. If most of the oil is extracted, and the hulls are subjected to a heat treatment, a not unpleasant flavor is developed.

The same cyanogenetic glucoside which has been found in linseed is present in the hulls, since they emit a faint odor of peach kernels when moistened and allowed to stand. The enzyme on which this reaction depends, however, can be easily destroyed, so that the hulls could be made entirely safe, just as linseed tea is safe due to boiling the seed. The amount of hulls ingested daily by a human for laxative purposes would not be dangerous in any case, even if they were not treated, as many times this amount would be required for harm to result.

HEMPSEED — It is believed that hempseed have not been decorticated in this country, although there are reports of this having been done on a small scale in other countries.

The seed consists of a hard, rather thick shell, and a soft white kernel. The hull is covered by a light brown, flaky, paper-like skin, which is said to be poisonous to canaries when the seed are used as birdseed; and it is lined by a thin, waxy, greenish skin, part or all of which may adhere to the kernel rather than to the hull. Mature kernels are usually pure white, although a small percentage are found which are greenish, these possibly being immature or damaged. A few brownish damaged kernels also occur.