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Some Challenges for the Rapeseed Crusher[1]

ABSTRACT

Processing of rapeseed has challenged the processor in ways which differed substantially from those that faced the soybean crusher. The newer varieties of rapeseed pose new processing challenges which will be met and surmounted.

INTRODUCTION

Rapeseed has been grown for centuries in Asia and in Europe. It is reported that, in the United Kingdom, rapeseed from the Baltic countries was crushed and the oil used for illuminating purposes in street lamps, as well as for lighting houses. Sailors from Russian ships which had brought cargoes of Baltic timber to the eastern coast of England would, on occasion, pilfer this oil from street lamps in cities, such as Hull, and use it for edible purposes; it would appear from this fact that their diet must have been fat deficient. The extraction of oil from rapeseed in those times was carried out by mashing the rapeseed and pressing it between plates. Pressure was developed on plates by hammering a wedge between the moveable plate and the supporting frame. A big step forward in pressing was the introduction of mechanical power to drive the wedges, and reports are that areas devoted to pressing processes were characterized by a din of hammering.

Early processes were obviously quite inefficient in terms of oil recovery. Improvements in the plate press followed slowly on both sides of the Atlantic; however, a substantial technological development occurred with the introduction of the continuous screw press in the earlier part of this century.

These recent developments plus that of solvent extraction need no review here. Rapeseed, however, has posed some unique problems to the processor, and these problems will be discussed in this paper.

QUALITIES OF RAPESEED

Canadian rapeseed is of two main strains: (A) *Brassica campestris*, more commonly known as Polish-type rapeseed, and (B) *Brassica napus*, often termed Argentine-type rapeseed. Both of these strains were introduced into Canada during the early part of World War II as a source of a marine steam engine lubricant for which this oil was superb. The presence of trace quantities of processing by-products went unnoticed or was considered unimportant and only became of interest when the oil was processed for food purposes.

Rapeseed is a very small seed which rarely excees 2 mm in diameter and contains 40% or more oil. The deoiled meal averages ca. 36% crude protein and 12% fiber. The fiber, whereas it is unduly abundant, is very short in nature and, as a consequence, contributes poorly to the physical stability of the furnish in both the expeller and solvent extraction processes.

PROCESSOR PROBLEM

Among numerous compounds present in rapeseed are small amounts of glucosinilates, as well as enzymes of which one, myrosinase, is of particular interest to the processor.

An interaction often may occur between the sulphur containing glucosinilates, moisture, and enzymes.

It would appear that there is a relative isolation of myrosinase or glucosinilates or moisture in the uncrushed seed. As a consequence, despite favorable reaction, temperatures, and other conditions prevailing, little or no interaction appears to take place. However, subsequent to rolling or physical crushing of the seed, mutual contact and reaction does occur, particularly at temperatures in the range of 125-175 F. The myrosinase reportedly acts as a catalyst to the hydrolysis of glucosinolates, with the resultant production of small amounts of isothiocyanates and oxozolodinethiones. These compounds are of concern to the crusher because: (A) in the oil, they act as hydrogenation catalyst poisons; and (B) in the meal, their action is that of growth inhibitors, particularly when used for the feeding of swine and poultry.

The early work of C.G. Youngs of the National Research Council and Jack Reynolds of the Saskatchewan Wheat Pool showed that the activity of myrosinase could be destroyed by heating to temperatures in excess of ca. 175 F. This has become the standard Canadian technique for preventing or minimizing the hydrolysis reaction. It is obvious, however, that some reaction still may occur during

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the interval required to raise the temperature from ambient to deactivation level, even though this interval is kept as short as possible. One might also speculate that another way to avoid the unwanted reaction would be to remove all possible moisture from the seed prior to crushing. Unfortunately, this is only a partial solution, since a certain level of moisture is as necessary as elevated temperatures for enzyme deactivation. With very low moisture, the hydrolysis certainly is minimized. However, myrosinase survives to cause problems at some later stage, particularly in the meal when adequate moisture level for hydrolysis may occur again.

SOLUTIONS

Agra's efforts have been directed along two fronts and are discussed below. We have increased our heating capability particularly in the early stages of cooking or conditioning. The object here being to minimize the time element required to exceed the deactivation temperature. To this end, we use large diameter stack kettles operating with as shallow a level of furnish as practical. Moisture content of the furnish as it enters the top kettle averages ca. 9%, and the top one or two kettles are not vented. After deactivation, the material is cooked further at 200 F and dried to a moisture content of 4 or 5% prior to pressing. We have found that, for good caking, the moisture level is quite critical within quite narrow limits.

Our objectives for the screw press cake are to have it contain 12-16% oil and not more than 5 or 6% moisture, which together with satisfactory physical structure, enables us to have good percolation of hexane through the bed in the extractor.

Canadian plant breeders recently have produced a number of varieties of rapeseed with very low levels of glucosinolate material. By largely eliminating glucosinolates, the development of processing techniques to accomplish enzyme deactivation now appears redundant. Our company cooperated with other crushers, the Canada Department of Agriculture, as well as the Canadian Rapeseed Association, in the growing of limited quantities of these varieties in 1973. A proportion of this production was allocated for experimental crushing, processing, and feeding trials. Most western Canadian crushers were involved in the crushing trials and found that these new varieties of rapeseed had entirely different crushing characteristics from those previously processed. The seed behaved differently in all stages right from flaking through prepressing to solvent extraction. All crushers reported similar behavior and results. It is obvious that we have a new ballgame on our hands which must be played and won. The stakes are high, and there is no question that techniques can and will be found to process this much improved seed.

Turning to the solvent extraction of prepressed rapeseed cake, we have not had good experience with flaking of press cake. Flaking has produced a fine granular type of product which has very poor percolation properties. For a time, we used a mild pulverizer with mixed results, insofar as percolation was concerned. We now do not treat the cake but merely convey it directly to the seal conveyor which feeds the extractor. This conveyor seems to break up the cake sufficiently to produce good percolation and acceptable extraction results. We have examined separately the fine and coarse meal coming off the meal cooler and, in general, find little difference in residual oil content. Only minor amounts of the coarse material would be retained on a quarter in. screen. Data does, however, show that a threshold or plateau of bound or unreleased oil still remains in both the fine and coarse material. We have released this bound oil only in the laboratory by extremely fine grinding prior to extraction in the Goldfisch extraction apparatus. In my opinion, it is very questionable whether this bound oil can be recovered practially in a commercial process. A further question is the true nature and composition of this material.

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Temperature and Frequency Dependence of Ultrasonic Velocity and Absorption in Sperm and Seal Oils

ABSTRACT

The variation of ultrasonic velocity and absorption in sperm oil and seal oil with temperature range of 5-55 C and frequency range of 1.5-60 MHz are measured. In both oils, the velocity increases ca. linearly with decreasing temperature and increases with increasing frequency; the absorption increases not only with decreasing temperature but also with decreasing frequency.

TABLE I

Some Chemical and Physical Properties

Property	Sperm oil	Seal oil
Water content and volabiles	0.10%	0.46%
Impurity	0.72	0.68
Acid value	0.04	0.05
Iodine value	79.1	141.1
Peroxide value	13.5	59.5
Saponification value	131.4	195.4
Unsaponifiable (percent)	38.20%	1.28%
Mp	11 C	5 C
Refractive index, N^{40}	1.457	1.470

INTRODUCTION

In recent years, many authors have published the temperature and frequency dependence of ultrasonic velocity and absorption in liquids, solutions, polymeric substances (1-3) and high viscosity plant oils (4-8). However, there is little data about the oils of sea animals. In the present paper, the authors report the experimental results of the temperature and frequency dependence of ultrasonic velocity and absorption in sperm and seal oils. Some