Cellular Ultrastructure of Jojoba Seed

ABSTRACT

Jojoba seed, examined with an electron microscope, appeared ultrastructurally similar to other oilseeds, even though liquid wax, rather than triglyceride, comprises the reserve lipid of the seed. This observation indicates that liquid wax and triglyceride are stored in the same manner—in spherosomes—within seeds.

INTRODUCTION

Oils of oilseeds are principally triglycerides. However, monobasic esters of unsaturated long chain fatty acids with fatty alcohols comprise the unique oil of jojoba seeds. (For reviews of physiochemical properties and practical uses of jojoba seed oil, see references 1-3).

Since morphologically identifiable spherosomes are the intracellular repository sites of reserve triglycerides in oilseeds (4), determination of the mode of storage of the unique wax in jojoba seeds was of interest.

EXPERIMENTAL PROCEDURES

Pieces of dry, quiescent jojoba seed (*Simmondsia californica Nutt.*) were placed over water in a petri plate for 2 hr; smaller pieces, ca. 1 mm^3, then were excised from this pliable tissue. These pieces were fixed in 2% $KMnO_4$ for 3 hr, rinsed with water, dehydrated in a graded series of aqueous acetone solutions, and embedded in epoxy resin according to Spurr (5). Thin sections were cut with a diamond knife on a Sorvall Porter-Blum microtome and examined with a Philips EM-200 electron microscope.

RESULTS AND DISCUSSION

Figures 1 and 2 show representative electron microscopic fields of typical cells that comprise the cotyledonary storage tissues of quiescent jojoba seeds. The cells appeared morphologically similar to corresponding cells of commercially important oilseeds, such as castor (6), cotton (7), cucurbit (8), peanut (4), soy (9), and tung (10). The greater portion of the intracellular cytoplasm of jojoba, as in that of the above mentioned seeds, consisted of two organelles: spherosomes, which contain lipid (4), and protein bodies (aleurone grains), which contain storage protein (11). Globoids, which contain metallic salts of phytic acid (12), were embedded within the protein bodies. Other intracellular organelles, such as mitochondria, plastids, and endoplasmic reticula, all of which rarely are observed in the cytoplasm of quiescent seed cells, were not readily apparent in jojoba seeds.

Though jojoba seeds are unique in that liquid wax, rather than triglyceride, is the storage lipid, the intracellular sites of wax deposition in jojoba were ultrastructurally similar to those of triglyceride in other oilseeds.

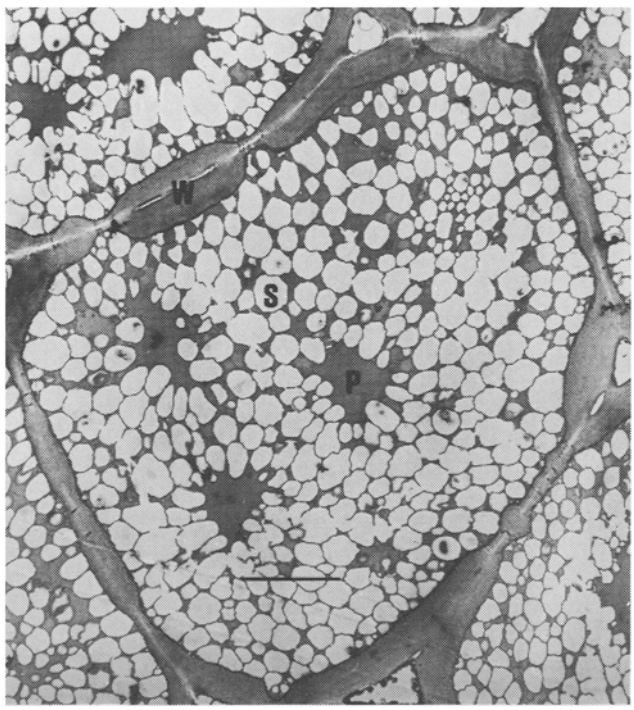

FIG. 1. Cotyledonary tissue of jojoba seed. W = cell wall, P = protein body, S = spherosome, and G = globoid. The bar represents 5 μ.

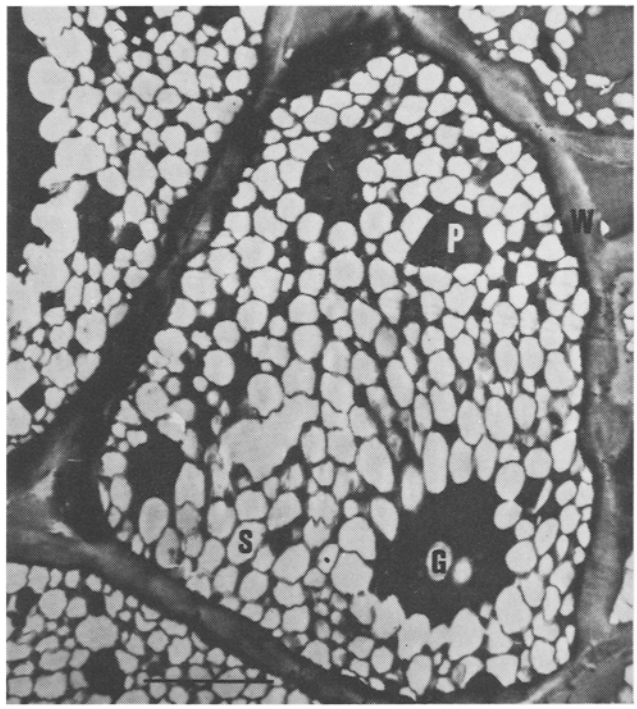

FIG. 2. Cotyledonary tissue of jojoba seed. W = cell walls, P = protein body, S = spherosome, and G = globoid. The bar represents 5 μ.

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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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