methionine in peanut flour. The author reports (7) that characteristics of the blends are such that they may be used in cloudy, fruit-flavored or milk-like beverages or as meat extenders and in bakery goods.

The peanut flours have also been used to prepare protein isolates with a protein content of over 90%.

A series of partially defatted peanut flours with 50% to 60% of the oil removed by hydraulic pressing of raw peanuts is being produced. The pressed peanuts, either as is or roasted, are ground into a flour. This treatment produces flours ranging from a white, essentially bland flour to those having increasingly darker colors, that is, tan to brown, and containing a nutty flavor. These flours have about 30% protein and 33% lipids. They are useful in a variety of products. The bland flours are particularly useful in food systems in which other flavors are to be picked up, whereas the other flours can be used in foods requiring a peanutty flavor.

The partially defatted peanut flours have been evaluated in products such as dry cookie and cake mixes, peanut soup, peanut butter candy, as a replacement for caseinate in a wide variety of foods, as a chocolate extender, and in the preparation of bacon bits.

Full-fat peanut flours have been prepared by several organizations. In general, preheated peanut flakes are ground, made into slurry with water, and drum dried or spray dried. Several uses have been suggested for this flour: as meat extenders using up to 20% flour; in potato flakes using 25%, 50%, and 75% flour; in the formulation of boneless chicken and turkey rolls; in simulated coconut candy; and in cheese-peanut flakes.

The potential for increased consumption of peanut products is appreciable, because peanuts are an important source of food protein. Peanut flours and concentrates are an effective means of utilizing peanuts as a source of food protein.

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Chemical Constituents and Protein Food Processing of Rapeseed

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ABSTRACT

In rapeseed, as in other oilseeds, there are some substances that adversely affect nutritional value. By application of appropriate technological processes, the antinutritive factors are removed and the final protein products appear to have high nutritive value. Compared with the soybean, rapeseed presents some unique problems. When processing rapeseed into protein foods, it is necessary to take into account high losses of nitrogen substances (nonprotein nitrogen), and higher costs of removing glucosinolates and their derivates, as well as phenolic compounds. Technically and economically feasible methods of reducing cellulose and phytate contents should be developed. In view of the presence of many constituents which lower the nutritional value of rapeseed protein products, it would appear that rapeseed is presently not a suitable raw material for production of food grade protein flour and grits. On the contrary, rapeseed protein concentrates and their texturates have satisfactory nutritional quality and feature good functional properties. Rapeseed isolates, except for poorer spinning properties, have similar characteristics to those of soybean isolates, but, as a result of low protein yields, their production is uneconomical. Recent progress in the breeding of glucosinolate-free and low fiber rapeseed varieties offers a new approach for development of processing methods for useful protein products based on this raw material.

Rapeseed is of interest especially in the Northern and Central European countries and in Asia, as a raw material for the production of protein food. In these regions of the world, rapeseed is well adapted to climatic conditions, and it also features a high level of essential amino acids. Nevertheless, processing it into a protein food is much more difficult than processing soybean, both because of the nonprotein constituents of the fat-free meal, and the fact that it contains substances of an antimetabolic nature. In practice, the latter makes it impossible to obtain food grade protein flour and grits directly from the rapeseed. It is possible, however, to obtain high quality protein concentrates and isolates after removing certain constituents, which will be discussed using data from our investigations.

First of all, rapeseed is substantially different from soybean in basic constituents. While the oil content is more than twice that of soybean, the protein content of both seed and meal are substantially less (Table I). However, rapeseed proteins are rich in lysine, sulphur-containing amino acids, and other essential amino acids (Table II).

Rapeseed contains several antinutritional factors which have adverse effects on animal performance and limit the potential for obtaining food grade flours from deffated meals. These include nonprotein nitrogen compounds, oligosaccharides, crude fiber, phytins, phenols, glucosinoleates, trypsin inhibitors, and hemagglutinins. Nonprotein nitrogen is present in rapeseed in much greater quantities than in the soybean. This fraction is composed of peptides and free amino acids, the products of the incomplete synthesis or hydrolysis of proteins, and also nucleic acids, glucosinolates, ammonia, nitrogen and other N-containing substances. Since a great part of the nonprotein nitrogen substances remains soluble when proteins are

TABLE I

Composition of Rapeseed and Soybean Cultivated in Poland (% Dry Basis) (1,2)

Content of	Rapeseed		Soybean	
	seed	meal	seed	meal
Oil	48	---	20	---
Protein[a]	23	44	43	54
Carbohydrate	25	48	32	40
Ash	4	8	5	6

[a]N x 6.25.

TABLE II

Content of Essential Amino Acids in Rapeseed and Soybean Meal (3)

	Rapeseed	Soybean
lysine	5.8	6.5
met + cys	4.5	2.2[a]
thr	4.0	3.7
try	1.5	1.8
leu	6.0	7.5
ileu	3.8[a]	4.2
val	4.8	4.2
tyr	2.6	2.6

[a]First limiting amino acids.

TABLE III

Content of Sugars in Rapeseed and Soybean Meals (% Dry Basis) (8)

	Rapeseed	Soya
Fructose	0.04	0.46
Glucose	trace	trace
Sucrose	6.94	3.99
Raffinose	0.41	0.74
Stachyose	2.39	6.26

precipitated at the isoelectric point, their high contents distinctly reduce the yield of protein concentrates and isolates. About one-third of rapeseed N remains in solution during protein isolation.

The contents of peptides and free amino acids in the nonprotein nitrogen of rapeseed meal amounts to 7.2% and 13.3%, respectively, or 2.4% of the meal weight. Out of this group of compounds, only free amino acids have some value as food constituents. All the essential amino acids except threonine are present in the fraction. The occurence in rapeseed of five neutral peptides has been established by electrophoresis (4), while acid and basic peptides were found to be absent.

Sugars are present in rapeseed in significant quantities (Table III). In contrast to soybean, sucrose is the principal sugar, followed by stachyose and limited amounts of raffinose. Insoluble polysacharides (crude fibers) are mainly concentrated in the hull, which, depending on the variety and shape of the seeds, accounts for 12-20% of the seed weight. Cellulose plus lignin and hemicellulose are the main polysaccharides in rapeseed, and their presence makes it impossible to obtain, by classical methods, concentrates with a high content (ca. 70%) of protein. Only the removal of the hull from the rapeseed enables concentrates of a higher protein content to be obtained, but usually not higher than 55%.

Phytin, a typical phosphorus constituent in most seeds, occurs in rapeseed in the form of phytic and as its magnesium and calcium salts. In terms of protein, its content in the seed, concentrate, and isolate are five-fold higher than in soybean (Table IV). It affects, unfavorably, the solubility of proteins and mineral utilization in the organism. The

TABLE IV

Phytin Phosphorus in Rapeseed and Soybean Products (6-8)

	Seed	Concentrate	Isolate
Rapeseed:			
mg/g	9.3	15.5	23.4
mg/g/protein	31.6	27.7	26.1
Soybean:			
mg/g	4.3	4.1	5.9
mg/g/protein	7.0	6.1	6.5

TABLE V

Glucosinolate Content in Rapeseeds, in mg Aglucones/g Meal (12)

	3-butenyl ITC	4-pentenyl ITC	OZT	Total
Meal (high glucosinolate)	3.3	1.0	10.7	15.0
Concentrate	0.1	trace	0.1	0.2
Isolate	0.0	0.0	0.0	0.0
Meal (low glucosinolate)	0.3	0.1	0.6	1.0

TABLE VI

Activity of Trypsin Inhibitors in Soybean and Rapeseed (13)

	Flour	Concentrate	Isolate
Rapeseed			
TUI/mg sample	2.3	1.9	trace
TUI/mg protein	3.3	1.9	trace
Soybean			
TUI/mg sample	81.4	27.7	20.0
TUI/mg protein	150.7	41.0	21.8

association of the phytates with the proteins is relatively strong (Table IV), and it is a protein to remove them using the standard production methods. Hence, the development of methods for reducing the phytate in rapeseed food products by strong alkali or acid conditions are ways of solving the problem, but milder conditions would be preferred.

Phenolic compounds are present in rapeseed in much greater quantities than in soybean. This group of compounds in rapeseed is represented, first of all, by the phenolic acids. Among them the salicylic, p-hydroxybenzoic, vanillic, gentisic, siringic, p-cumaric, isoferulic, ferulic, caffeic and sinapic acids have been found to be present (9-11). Sinapic acid is the principal phenolic acid in the free form and in the bound forms, after acid or basic hydrolisis. Sinapic acid is derived from sinapine which contributes the specific, sharp, bitter flavor to rapeseed flour. Phenolic acids and other phenols easily react with the proteins, which can take place during the separation of protein from the rapeseed, thus reducing the nutritive value of the product. Additionally, as a result of enzymatic and nonenzymatic reaction/air oxidation under alkaline pH, the phenol compounds may produce dark colored complexes.

Glucosinolates and their derivates which occur in rapeseed have been described by many authors. In Polish cultivars, glucosinolate levels are still very high (Table V). Recent success obtained by breeding of low glucosinolate rapeseed varieties give a new favorable perspective in its use for processing of edible flour concentrates and isolates. For sensory and health protection reasons, they must be removed completely in the production of flour, concentrates and isolates. Due to the high solubility of glucosinolates in water, excellent results can be obtained by diffusion extraction from whole seed, before their hydrolysis by myrosinase. This is one of the few procedures which offers the possibility of obtaining concentrates almost completely

free of the glucosinolates (Table V). The glucosinolate extraction process is increased by the employment of weak NaOH solution or polar solvents such as methanol, ethanol, or acetone. The diffusion method can reduce the relatively high losses of nitrogen substances which are soluble in water. In the process of obtaining rapeseed protein isolates, the glucosinolates and products of their degradation are removed in the protein precipitation process, together with the wastewater.

The partial reduction in levels of the glucosinolates, isothiocyanates and vinyloxazolidinethiones in the extracted meal can be obtained by toasting, but deleterious protein changes occur during toasting which would preclude using intense heat to produce food protein products.

The antitryptic agents particularly active in the pulse seeds, are much less active in rapeseed (Table VI). This protein is highly sensitive to the effect of temperature and is effectively destroyed during toasting.

The hemagglutinins with glycoprotein structures occur both in the soybean and in the rapeseed in similar, small quantitites, and their presence in the finished product is not a critical problem from a nutritional point of view.

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Wheat Gluten Applications in Food Products

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ABSTRACT

Vital wheat gluten has traditionally been noted for its functional benefits in various bakery applications. In recent years extensive research and development work has taken place to more clearly identify wheat gluten's unique characteristics and functional properties. As a result, many new and novel applications have been developed. The on-going potential of this exciting protein ingredient, in its native or modified forms, will only be limited by the imagination of those formulating new products.

INTRODUCTION

The major use of vital wheat gluten to date has been in bakery applications, where it has contributed to dough strength; gas retention and rise; improvements in texture, rigidity and bite in the finished products; flavor improvement; hinge strength in buns and rolls; and increased water absorption.

Many flour millers have used vital wheat gluten to streamline production. Instead of milling usually expensive wheat blends to meet bakery flour standards, lower cost local wheats can often be used with wheat gluten supplementation to satisfy functionality requirements. In recent years the unique properties of this protein ingredient have been utilized in various other food formulations.

WHEAT GLUTEN PROPERTIES

The natural properties of vital wheat gluten may be broadly summarized as physical and structural uniqueness; complementary nutrition; and complementary flavor and color.

Physical and Structural Uniqueness

Table I shows a typical analysis of vital wheat gluten.

Native wheat gluten fractionates into two different classes of proteins: gliadin and glutenin (Figure 1.). Hydrated gliadin is an extensible syrupy material, whereas hydrated glutenin is a cohesive and rubbery mass. Together they make wheat gluten "vital" and "alive," unlike other natural plant proteins. This vitality in hydrated gluten is clearly illustrated in the following structural and functional proerties.

Ability to form a visco-elastic mass. With a certain amount of mixing, hydrated gluten develops into a firm, resilient, and adhesive substance, insolube in water and exhibiting both plastic and elastic properties.

Ability to form films. When the formed visco-elastic mass is further mixed, it develops into a continuous three-dimensional webwork of films. Solid particles as well as gas bubbles may, thus, be enveloped throughout this continuous gluten mass.

Thermosetting ability. When heated above 85 C, the hydrated gluten mass coagulates irreversibly and without loss of its unique structural order, yielding a firm, non-sticky, moist, clean cutting and resilient gel.

In practice, these gluten properties play important roles. Once hydrated, gluten's visco-elastic character provides a structural basis on which a food system may be built. Its adhesive and film-forming property binds the system's particulate matter (e.g., starches, meat tissues, fat globules). Its thermosetting attributes upon cooking entrap and bind together the originally discrete particles and help retain moisture and gases evolved. Finally, the firm, moist, clean cutting, and resilient character of cooked gluten films contributes to end product quality.

TABLE I

Typical Analyses of Vital Wheat Gluten

Protein N x 5.7, dry basis, (d.b.)	75.0%-80.0%
Moisture	5.0%- 8.0%
Ether extractable fat, d.b.	0.5%- 1.5%
Ash d.b.	0.8%- 1.2%
Water absorption capacity	150%- 200%