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Y. Andersson, U. Nilsson, S.G. Svensson and I. Qvist

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LITERATURE REVIEW, NEW PROTEINS 1.7.1973 - 30.6.1974

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ABSTRACT

This literature review on new proteins in conventional and unconventional foods was conducted at the Swedish Institute for Food Preservation Research (SIK) with the aid of grants from the Swedish Board for Technical Development (STU). This report is a continuation of four earlier reports to the Swedish Board for Technical Development (STU-rapport 69-275/U175, 69-842/U643, 70-199/U175 and 71-834/U672, 72-823/U343). They are also published as SIK-Reports Nos. 250(1969), 283(1970), 299(1972), and 338(1973) respectively.

The review is a result of a continuous literature survey at SIK's library as well as a computer literature search in e.g. Chemical Abstracts and Food Science and Technology Abstract.

The information is primarily categorized as to the source of protein, fish protein concentrate, other animal proteins, oil seed proteins, other vegetable proteins, and microbial proteins, and then evaluated for the following features: processing, use and functional properties, nutritional value and toxicology, economy, acceptance and future development.

The references with short comments are given in a bibliography with subheadings.

A survey of articles published on unconventional proteins is published as STU-rapport 70-199/U135 (in Swedish).
A. REVIEW ARTICLES

Anon.  
How to help with protein.  

Anon.  
MARM symposium airs nutrition problems.  

Anon.  
Protein fibre foodstuffs.  
USSR, Ordena Lenina Institut  
Elemento-organiceskikh,  
Brit. Patent 1 310 005 (1973)  

Anon.  
Swedish porridge and milk  
for catastrophe areas.  
Svenska Mejeritidn.  

Araujo, J.S.  
Food staples as vehicles for  
protein concentrates.  
p. 85-90.

de Cremiers, P., Maubras. Y.  
The use of new sources of  
proteins for human nutrition.  
Institut National de la  
Recherche Agronomique,  
Au Cerdia - Rue des Olym-  
plades, Massy (91,305)  
France (1972) 113 p.

Comments

Some problems concerning unconventional proteins from soy bean, fish  
and plants are discussed including difficulties in distribution and the  
restrictively high prices.

Examples of fortified and unconventional products with high nutritional  
values are given. The trade marks and the producers are named.  
Different kinds of beverages, pastas, and textured soyfoods together with  
microbially synthesized protein and whey protein are discussed.

Imitation meat and other foods are  
prepared from a gelatinous preparation containing proteinaceous mate-
rial and a gelling agent. The constituents are mixed with a polyvalent  
metal ion to effect coagulation,  
after which the coagulate is heated  
and homogenized to form a paste. The paste is subjected to an applied  
load to form a fibrous structure  
oriented in the direction of load  
application.

The contents of porridge, gruel,  
bead and milk are tabulated. These  
products have been sent to West  
Africa and Pakistan by the Swedish  
Red Cross.

The enrichment of corn and cassava  
meals was studied by using dried  
skimmed milk, soy protein extracts  
food yeast and DL-methionine. Corn  
meal had its crude protein content  
increased from 8 to 21 % and cassava  
meal reached a crude protein content  
of 12.2%. Enriched food staples have  
not shown any loss of palatability.

Unconventional protein sources from  
oilseed cereals, leaves, fish and  
microorganisms are discussed from  
the technical and the economical  
aspects.  
A reference list is included in  
each chapter.
FN's role in developing new foods for USDA child feeding programs.
Bird, K.


Herbert, R.
One day - you'll be eating strange things.
Food Ind., South Africa 25(1973):12, p. 31-33.

Holmes, A.W.
Substitute foods - a practical alternative?

Hughes, D.
New protein foods and the future demand for meat.

Jaenecke, H.-U., Petzold, H.
Use of protein preparations in the manufacture of bakery products.

Comments

New products for school lunches, such as textured vegetable proteins and high protein macaroni are described.

The molecular structure of proteins is described. Structures of raw and prepared foods are reviewed. The possibilities of directing the food structure with the aid of proteins are discussed.

Presents a general discussion of unconventional protein sources. Experiments with fish protein concentrates in crackers are described.

The requirements for the provision of human food are reviewed and problem areas identified. Recent developments in texturizing soya meal and in spinning vegetable proteins are described and their use critically evaluated.

Two categories of "new" protein foods are distinguished, firstly, the more traditional vegetable based proteins and, secondly, those derived from bacteria, fungi and yeast. The conclusions drawn are that the former is more likely to affect the catering and prepared meat sectors of the food industry whilst the latter has more potential for posing a direct threat to the fresh meat trade.

Use of protein concentrates and extracts (from milk, soybeans, groundnuts, peas, cottonseed, sesame seed, fish, marine algae and microbial biomass) and lysine for fortification of bread and other bakery products is discussed. The quantity of added protein is limited by adverse effects on the quality of the product; these adverse effects can be minimized by modification of processing methods or use of other additives.
Comments

A progress report of nutritional enhancement efforts that began in 1941. The development of a corn-soy-milk blend is described.

The best means for increasing the protein level in food is discussed. Fortification of well established products is recommended. Processes for preparing a) beverages b) powders c) structured products are described.

Re-emphasises protein rich crops such as oats, peas, leafy vegetables as a solution to the chronic protein shortage.

Biological evaluation methods, tables of utilizable protein scores with their relative nutritive values and relative cost, together with amino acid fortification of food are discussed.

A spinning solution containing protein as the main ingredient and having a pH of 5.5-11.0 is continuously extruded into a coagulation bath containing polyacrylic acid.

The antioxidant activity of textured soy bean protein on beef lipids was studied. The textured vegetable protein exerted a marked antioxidant effect on the lipids. Vegetables influenced the rate of oxidation but by no means to the same degree as did the textured vegetable protein.

Simulated meats and fortified meat products are discussed from several points of view: sources of raw materials, processing methods, production and marketing, factors influencing competition with natural meats.

The use of different plant proteins are described. Results of chemical analyses and aroma analyses are given for 12 kinds of plant proteins.
Shulz, M.E.
Development of protein-enriched food, dishes and drinks with reference to covering the need for protein in human nutrition.

Shellengerber, J.A.
The status of high-protein bread.

Smith, G. et al.
Efficacy of protein additives as emulsion stabilizers in frankfurters.

Spicer, A.
Novel proteins.

Spinelli, J. et al.
Preparation and properties of chemically and enzymatically modified protein isolates for use as food ingredients.

Protein hydrolyzate for foods.
Yokotsuka, T. et al.

Teply, L.J.
What kinds of food should primarily be provided, particularly for young children, in famine?
Famine, a symposium dealing with nutrition and relief operations in times of disaster.
Blix, G. et al.

Comments

Dairy and food industries are recommended to follow a program given to facilitate high protein uptake by the consumer.

High protein bread enriched by milk solids, vital gluten or soy-flour is defined. The use of additives and the present research is described. 25 references.

Frankfurters of 4 different fat contents were prepared using meat (control) or meat plus 3.5% of 11 kinds of protein additives. The following properties were studied: water retention capacity, emulsion stability, appearance, and microstructure. (18 ref.)

The background and a general discussion of novel protein is presented. Fungal proteins produced in the author's laboratories are described. Details of production methods and nutrition values are included.

Protein hydrolyzates of high free amino acid content, useful as a spice for foods, may be prepared by fermentation using NaCl-resistant lactic acid bacteria.

The basic nutritional needs in emergencies are discussed. The conclusions were that modern food technology can make cereals more acceptable, nutritious and convenient to use.
B. FISH PROTEIN CONCENTRATE

1. Reviews


Comments

Fish protein concentrate as a food supplement is discussed with reference to:
1) types of product
2) quality and safety
3) acceptability
4) utilization
5) resources

Discussions on FPC with reference to:
1) production methods
2) economies of production
3) economies of consumption

History, background and aim of the ASTRA protein project

Chemical composition, protein content, nonprotein N and biological value of fish are briefly discussed. Amino acid composition of cod, haddock, lemon sole and herring is tabulated. Experiments on the use of fish flour as a protein supplement are reviewed.

The following headings are discussed: definition and principles of manufacture; nutritive value of insoluble fish protein concentrate; potential market and developments; principles of manufacture of the soluble product; nutritive value of soluble fish protein concentrate; and potential market and developments. An appendix gives tables showing the chemical composition of various fish protein concentrates.
Knobl, G.M., Jr.  
Fish Protein Concentrate: The state of the art.  

Mautner, M.  
UNIDO can help upgrade FPC.  

Miyauchi, D., Kudo, G. & Patashnik, M.  
Surimi - A semi-processed wet fish protein.  

Okada, M., Miyauchi, D. & Kudo, G.  
"Kamaboko" - The giant among Japanese processed fishery products.  

Pariser, E.R.  
Proteins of aquatic origin as foods for human consumption.  

Sikorski, Z.E. & Naczk, M.  
Possible modifications of technological properties of fish protein concentrates.  

Comments

Different aspects on modern FPC production are discussed.

The process developed by UNIDO for the production of an improved fish meal is discussed; known as upgraded fish meal (UFM) this product is superior to the conventional fish protein concentrate (FPC) in colour, odour, taste and level of protein denaturation. The improved FPC could be used for protein enrichment in bakery products, dietary preparations and fish hatcheries.

By being processed into surimi, the fish muscle proteins retain for a longer time the functional properties required for making good "Kamaboko" and fish sausages. The preparation procedure and factors affecting the quality of surimi are described.

Production, types and factors affecting quality of Kamaboko are described.

A review on the protein resources, the raw material utilization, forms in which the protein is consumed, consumers preference and demand and trends on the utilization of aquatic protein resources.

Review.
Snegov, S.
The ocean - a source of tasty foods.

Stillings, B.R.
New foods from the sea in
The promises and problems of the new foods.
Ed. Caster, W.O.
Report number 3 of the Inter-institutional committee on nutrition,
Univ. of Georgia, Athens, Georgia, Oct. 1970

Production of Fish Protein Concentrate,
Report and proceedings on the Joint UNIDO/FAO Expert Group Meeting, Rabat,

Comments

The nutritive value of fish is discussed and methods of preservation such as freezing and radiation are outlined. The processing of shark meat and krill, and potential uses of fish protein concentrate are also considered.

The following subjects are discussed:
  a) processing of FPC.
  b) characteristics of solvent-extracted FPC.
  c) problems associated with the processing and utilization of FPC.
  d) availability of FPC.
  e) marketing of FPC.
2. Processing

Anon.
(Astra Nutrition AB)
Fish protein.
British Patent 1 313 053 (1973)
Source: Food Sci. & Technol.

Anon.
(Kikkoman Shoyn Co.Ltd.)
Fish protein concentrate
Source: Food Sci. & Technol.
Abstr. 6(1974):2, R 75.

Anon.
(Nestle's Products Ltd.)
British Patent 1 322 243 (1973)
Source: Food Sci. & Technol.

Anon.
(Unilever NV)
Method for the manufacture
of a protein-containing
food product.
Netherlands Patent
7 309 172 (1974)
Source: Food Sci. & Technol.

Anon.
(Unilever NV)
Method for manufacturing
a fish product.
Netherlands Patent
7 215 067 (1973)
Source: Food Sci. & Technol.

Comments

Strips of fish meat are washed in water, sprayed with pressurized water, heated with direct steam and fed to a separator for removal of bones and other non-fibrous hard material. The remainder is homogenized, centrifuged to remove fat, soluble substances and skin fragments, and dried to prepare it for a solvent extraction step which removes residual fat and/or taste-altering materials.

A process is described for converting fish meat to a readily water-soluble or dispersible protein concentrate useful as a protein extender or fortifier.

Fish material is treated with aqueous alkali at 90-120°C to solubilize the protein, after which its pH is adjusted to 7-10 to precipitate insolubles. Lipids are then solvent extracted from the solution and the protein is recovered as a light coloured product having a bland odour and flavour.

A proteinaceous food product in the form of a thermostable gel is obtained by mixing, at a pH of preferably 8,5-9,5, a protein component (e.g. denatured fish protein concentrate powder) with a propylene-glycol ester of alginic acid (25% esterified carboxyl groups) to form a protein-alginate polymer which is insoluble in water. The product may be used in combination with comminuted fish muscle for the manufacture of fish fingers.

A fish protein isolate which may be considered suitable for human consumption is produced from fish waste material by
1) de-colouring while the protein material is in the non-dissolved state.
2) deodorizing by extraction with isopropanol and
3) removing bones by comminuting and mechanical screening in order to keep the fluoride sufficiently low.
Archer, M.C., et al.
Ragnarsson, J.O.,
Tannenbaum, S.R. &
Wang, D.I.C.
Enzymatic solubilization of an insoluble substrate, fish protein concentrate: process and kinetic considerations.

Cheftel, C.
Continuous enzymic solubilization of fish protein concentrate. Studies with recycling of enzymes.

Chu, C.-L. & Pigott, G.M.
Acidified brine extraction of fish.

Drawford, D.L.
Preparation of marine protein concentrate from hake.
Oregon Fish Commission, Portland.

Gasser, J. & Huster, L.B. (Nestle S.A.)
Process for protein separation from fish.
Swiss Patent 528 869 (1972)

Comments

Solubilization of fish protein concentrate (FPC) by Bacillus subtilis protease (Monzyme) has been investigated. Conditions have been defined which eliminate the problems of microbial contamination and salt accumulation.

A kinetic treatment revealed that enzyme is adsorbed to the surface of the substrate; the initial rate of reaction being proportional to the surface area of substrate exposed to the aqueous phase.

The effects of pH, temp., substrate and enzyme concentration on the hydrolysis of fish protein concentrate (FPC) by Pronase (from Streptomyces griseus) and Monzyme (from Bacillus subtilis) are described. Two continuous systems for FPC solubilization were devised. In one the Pronase solution was separated from the soluble peptides by ultrafiltration. In the other, there was a continuous addition of enzyme (Monzyme) to the substrate.

Ground hake (Merluccius capensis) was extracted with 8% brine (6% brine + seawater) that was acidified to a HCl/fish ratio of 1:50. The solid residue was separated by centrifugation and extracted with iso-ProOH to yield a high quality product.

Removal of lipid from comminuted whole hake flesh prior to drying with the overall objective of yielding a more acceptable and functional fish protein concentrate. Complexing of soluble proteins in aqueous systems with hexametaphosphate at reduced pH was shown to enable nearly a quantitative recovery of soluble fish proteins from aqueous extracts by centrifugation.

Protein, in the form of a white, soluble, tasteless and odourless powder, is extracted from fish by treating 5-15% (by wt.) of fish DM with 0.02-0.50 M alkali in an aqueous medium for 5 min. at 90-100°C. The pH is then adjusted to 7-10 by addition of H_2SO_4.
Gasser, J. & Juster, L.B.  
(contin.)

Gaffino, J., Hurm, A.  
& Lamotte, G.  
Process for cytolysis of fish, cytolysis products thus obtained and products derived from the latter.  
French Patent 2097636 (1972)  
Source: Food Sci. & Technol.  
Abstr. 5(1973):2, R 115

Comments

HCl or injection of gaseous SO2. Insoluble materials are removed by centrifugation. The dissolved protein is precipitated at pH 4.5-6.0 and separated by centrifugation. It is then washed with salt water and redissolved in the alkali. The dissolved protein is hydrolyzed with papain at pH 7-8, and the lipids are extracted by means of a solvent system of isopropanol and methylisobutyl ketone. The protein is then precipitated at pH 4.5-5.5 and spray- or freeze-dried. It is added to foods and beverages.

A stable fish cytolysate is obtained by subjecting whole fish or fish fragments mixed with viscera to enzyme action, sufficiently to destroy the cell membranes and release the juices without modifying them. The enzyme treatment takes place at pH 3.5-4.5 and 35-60°C and is stopped when the paste becomes fluid. The product is centrifuged to obtain an aqueous, a solid and an oily phase. The aqueous phase may be dried at ≤60°C to a paste or at 60-90°C to a powder. The product is used for human nutrition.

Hyder, K. et al.  
Development of a process for preparing a fish protein concentrate which can be reconstituted into a meat-like product.  
Source: Chemical Abstr.  
79(1973):7, 41036 R.

Högstedt, K.R.M. & Knutson, T.L.  
Protein from fish.  
Swedish patent 355722 (1973)  
Source: Chemical Abstr.  
80(1974):11, 58621

Fish was cut transversely, wetted with H2O, coagulated with direct steam in parallel current and after filtering bones and other non-fibrous particles, homogenized to release protein and encapsulated fat from the skin, and separated into a fraction containing mainly protein and a fraction containing fat, H2O-soluble substances and skin fragments. The protein fraction was dried, if desired, after pressing a solvent extraction of residual fat and other odor compounds.


Comments

Squid was investigated as a potential source of protein isolate. The various process parameters which influence extraction of protein (particle size, time, extraction pH, salt concentration, relative amount of solvent to squid tissue and temperature) were investigated.

Growth of bacteria, development of flavor precursors, and degradation of proteins are prevented by the addition to treated fish of a solvent (isoProH, sec. ButOH) in an amount equivalent to 15-20% of the retained H₂O.

The process requirements and properties of dehydrated squid protein prepared by a water extraction and spray dehydration process were studied. After removal of skin and viscera, a water soluble fraction was obtained by filtering the comminuted slurry which, when diluted and spray dried was converted into a powder having a very light colour. The product averaged 81% protein had an excellent water solubility and a good oil binding capacity as well as emulsion stability.

Proteolytic enzymes of fish may influence the yield of isolate obtained from whole and eviscerated fish by the mean isoelectric pH precipitation method.

The raw materials are washed, chopped roughly, broken up by use of heat, and pressed, preferably on board ship. The press cakes are granulated, dried, stored and in a 2nd stage, preferably on land, are extracted, comminuted and dried.
Comments

A method for pretreatment of fish for manufacture of fish protein concentrate is described. Fish are washed, coarsely comminuted, and salted or treated with vinegar to give a final concn. of 1% NaCl or acetic acid. The product is then heat treated at 110-115°C under a pressure of approx. 0.5 atm. Processing then proceeds as in DDR patent number 93094.

A high quality proteinaceous product is recoverable in 35% yield from fish waste by a process of peptide hydrolysis followed by a pepsin-catalyzed recombination of soluble peptides to form plastein.

In a pilot experiment with fillet waste from Petrale sole (Eopsetta jordani), the yield was 35% of total protein. Approximate composition of the product was: protein 96.1%; moisture 2.9%; ash 0.5% and lipid 0.0%.

Freshly captured fish is ground to a fine paste and treated with an enzyme, such as pronase, for about 90 min. The duration of hydrolysis determines the solubility and the consistency of the protein products. After treatment, the lipids can be removed rapidly and efficiently by centrifugation. The advantages of the process include superior organoleptic properties (flavor, color and odor).

Whole fresh or frozen fish is boiled in water to separate flesh from the bone and permit removal of oils generated during boiling. The resulting slurry is acidified comminuted, screened to remove fine solids and extracted with a bland solvent.

Process is described for obtaining a dry protein concentrate from fish in which the ground concentrate is soaked in a weak aqueous formaldehyde solution and dried to yield a product lacking the offensive odor of many fish meals.
Sharp, K.H.
Fish protein.
Canadian Patent 927 663 (1973)

Shigeo, I., Watanabe, T. & Kinumaki, T.
Studies on "Liquefied Fish Protein"
V. Yield of LFP in digestion of washed meat paste and whole fish.

Comments
Raw fish material is comminuted, soaked in a weak aqueous formaldehyde solution, partially dried, frozen, thawed, and further dried to yield a protein material lacking offensive odour and fit for human consumption.

The yields of LFP in the digestion of washed pollack meat with three commercially available typical enzymes, pronase-P from Streptomyces griseus, BNP from Bacillus polymyxa and OFP-10 from B. sp.-20 were studied.

The yield was determined for a four hour digestion, at a predetermined optimum temperature but unadjusted pH, with a 0.3 or 0.5% enzyme to substrate ratio. 95% of the total nitrogen in washed pollack meat was recovered into a liquefied product with 0.3% of pronase-P, while only 65 and 55% of nitrogen were recovered with 0.3% of BNP and OFP-10, respectively.

Washed Alaska pollack meat paste was mixed with the same weight of water and incubated with or without 0.3% of proteolytic enzymes. Polypeptides were mainly produced during autolysis at 55°C for 4 hr. With addition of the enzymes the mol. wt. of the products was lowered.

Sugii, K. & Kinumaki, T.
Liquefied fish protein.
VI. Comparison of composition in different products by the use of commercial proteolytic enzymes.

Tarky, W., Agarwala, O.P. & Pigott, G.M.
Protein hydrolysate from fish waste.

A process is described to utilize fish waste (FW) from a filleting operation by recovering proteinaceous material of high functional properties. Pepsin was used to hydrolyze FW from English sole (Parophrys vetulus). 78% hydrolyzed protein was obtained when 0.2% pepsin was added to a 2:1 FW-water mixture. When mixed with casein the protein hydrolysate gave PER similar to that of pure casein.
Toledo, R.T.
Preparation and properties of low temperature extracted animal (e.g., fish) protein concentrate.

Venugopalan, V., Chakraborty, P.K., James, M.A. & Govindan, T.K.
Protein from blanch liquor.

Woodbridge, R.G.
Manufacture of edible protein from marine animals by the use of ammonia.
US Patent 3754927 (1973)

Yokotsuka, T., Iwaasa, T., Okami, T., Noda, M. & Mitsuharu, F.
Protein hydrolyzate for foods.

Österman, S.O.
(Astra Nutrition AB)
Method for the production of a flavour- and odour-free and fat-free protein from fish.
Swedish Patent 350899 (1972)

Comments

Protein concentrate prepared by extraction of fish (deboned poultry by-products, pork back fat, and beef scraps with iso. PrOH) had good functional properties when the extraction was carried below 45°C.

A process for isolating edible protein from blanch liquor of prawn canning is described.

The process of making edible protein products from marine animals by removing undesirable matters through the use of solvents is greatly improved by carrying out the extraction in the presence of NH₃ or NH₄⁺.

Protein hydrolyzates with high concentrations of free amino acids may be prepared by fermentation of partially hydrolyzed fish meal by NaCl-resistant lactic and bacteria in the presence of <12% NaCl.

Fish material for the production of a protein product is boiled in a counter flow of live steam. The undesirable volatile components are extracted with a suitable solvent which is then evaporated together with removal of the undesirable components by a counterflow of live steam.
3. Economy

Anon.
PFC as factor in price reduction of protein costs
Ed. Knutson, L.
Astra Protein Letter

Gardner, S.
Food additives permitted in food for human consumption.
Whole Fish Protein Concentrate (WFPC).
Federal Register

Economics, marketing, and technology of fish protein.
Ed. Tannenbaum, S. & Stillings, B.

Comments

Discussion of the cost of a FPC fortified product "cost of utilizable protein".

Subject to a few stipulations WFPC may be used as a protein supplement in manufactured foods. The WFPC product label must state as a protein supplement intended for regular use by children up to age 8, the amount of WFPC shall not exceed 20 grams per day. When used as a protein supplement in manufactured food, the total fluoride content of the finished food shall not exceed 8 p.p.m. based on the dry weight of the food product.

A review of the present state of fish protein concentrates and their future potential as a significant source of dietary protein. Fields such as the extent of fish resources, processing methods, nutritional evaluation, application in foods, economic aspects and marketing are included.
1. Toxicity

Archer, M.C., Stillings, B.R., Tannenbaum, S.R. & Wang, D.I.C.
Reduction in mercury content of fish protein concentrate by enzymatic digestion.

Lee, S.Y., Richardson, T.
Use of thiolated amino-ethyl cellulose to remove mercury bound to solubilized fish protein.

Newberne, P.M., Glaser, O. & Friedman, L.
Biologic adequacy of fish protein concentrate in five generations of mice.

Paskell, S.L. & Goldmintz, D.
Bacteriological aspects of fish protein concentrate production from a large-scale experiment and demonstration plant.

Spinelli, J., Steinberg, M.A., Miller, R., Hall, A. & Lehman, L.
Reduction of mercury with cysteine in comminuted halibut and hake fish protein concentrate.

4. Comments

The effect of proteolytic digestion on the distribution of Hg in fish protein concentrate (FPC) has been investigated. A 2- to 7-fold concn. of Hg in the insoluble FPC fraction and a corresponding reduction of Hg level in the soluble FPC fraction were achieved after proteolysis.

Thiolated amino ethyl cellulose (TAEC) was prepared. Mercury was removed from solubilized tuna fish protein concentrate by stirring with TAEC at pH values from 6 to 11. Under reducing conditions, that is, TAEC treated with dithiothreitol, and the Hg removed under N₂, 80% removal from a 2% protein solution at pH 7 was achieved.

Nutritional value, safety and acceptability of fish protein concentrate (FPC) prepared from whole red hake (Urophycis chuss) as sole source of protein were evaluated in large numbers of mice from conception through 5 generations. Reproduction and food efficiency in FPC groups were equal to or better than those of casein or chow-fed mice.

Freshly caught fish were stored in tanks of refrigerated brine. Processing comprised deboning, comminution with isopropyl alcohol extractions, solvent removal, drying of the crude product and finally milling in a "clean room". Bacteriological examinations were made of the raw material and at subsequent processing stages. There was no correlation between bacterial contents of the raw fish and of the final product; the latter comprised mainly Bacillus subtilis.

A study was made to determine the effectiveness of cysteine in reducing the Hg content of comminuted fish and fish protein concentrate (FPC). Commminuted fish tissue was extracted with 0.1 M NaCl containing cysteine in concn. ranging up to 0.5%. The amount of Hg that could be extracted from the fish was related to the concn of cysteine and the pH of the tissue but the relation...
Spinelli, J., Steinberg, M.A., Miller, R., Hall, A. & Lehman, L. (contin.)

Comments

was not linear. Fish blocks were prepared from the cysteine-extracted comminuted tissue and did not develop off-flavour during storage, when cysteine was added to the isopropyl alcohol used to prepare FPC. The Hg in the FPC was reduced up to 50%.
5. Nutritional value and properties.

Cheermin, Yu. A.
Amino acid composition of fish protein concentrate from caspian sprat.

Dubrow, D.L.
Effect of drying and desolventizing on functional properties of fish protein concentrate (FPC).

Dubrow, D.L., Kramer, A. & McPhee, A.D.
Effect of temperature on lipid extraction and functional properties of fish protein concentrate (FPC).

Fujimaki, M., Aral, S., Yamashita, M., Kato, H. & Noguchi, M.
Taste peptide fraction from a fish protein hydrolysate.

Comments

16 amino acids are determined in unfermented and fermented protein concentrates from Caspian sprats. No significant differences between the two protein concentrates were found.

Whole fish, red hake (Urophycis chuss) was five-stage countercurrent extracted with isopropyl alcohol (IPA) at temperatures of 20, 40 or 50°C to determine the effect on lipid extractability and functional properties of the FPC's produced. Five stages of extraction at 20°C reduced the residual fish lipids to about 10%. At 40 or 50°C extractability of lipids required only four or three stages respectively, to produce an FPC with 0.5% residual lipid or less.

Studies were undertaken to improve the functional properties of fish protein concentrate through the use of proteases and also to give rise to acceptable flavors. Pepsin, peptidase, molsin, papain, pronase, and bioprase were compared for their ability to generate tastes from fish protein concentrates. Pronase was selected as an enzyme producing a large amount of broth tasting peptides.
Hoskins, F.H. & Loustaunau, J.
Fish protein concentrate as a mineral nutrient source. 

Quantitative determination of dimethyl- and trimethylamine in fish protein concentrate. 

Rasekh, J. & Metz, A.
Acid precipitated fish protein isolate exhibits good functional properties. 

Comments

Fish protein concentrates prepared by a standard procedure from bluegill (Lepomis macrochirus), threadfin shad (Dorosoma petenense), spade fish (Chaetodipterus faber), and croaker (Micropogon undulatus) contained < 0.5% fat and had a min. level of 70% protein and similar levels of H2O (7, 5-8, 1%) and solids (91, 8-92, 4%). A 10-g portion of the products could contribute 15-25% of the adult protein requirement, 50% of Recommended Daily Allowance for Ca, 20% for P, 50% for Fe, and 50% for Mg. F levels were below 25 ppm.

Dimethylamine (DMA), 25-150 ppm, and trimethylamine (TMA), 5-10 ppm, were detected in samples of fish protein concentrate (FPC) prepared from frozen red hake (Urophycis chuss) and Pacific hake (Merluccius productus) by isopropyl alcohol extraction. Some other compounds are also identified by combined GLC-MS.

The production of an acid precipitated fish protein isolate is described. The isolate had a slight fish flavor and could be used as a binder in meat emulsion products similar to frankfurters, bolognas or luncheon meats.
C. ANIMAL PROTEINS OTHER THAN FISH PROTEIN

1. Milk proteins

Borst, J.R.
Milk proteins for use in the food industry.
Food Techn. in Australia 23(1971):11, p. 544-551

Brouwer, F.
Use of milk components in industrial food production.

Conrad, P.
Possibilities of using milk proteins in the meat industry. (Ge.)

Demott, B.J.
Nutritional value of casein and whey protein.

Forsum, E. et al.
Fortification of wheat by whey protein concentrate, dried skin milk, fish protein concentrate and lysine monohydrochloride

Gennip, A.H.M.
Milk proteins and their use in some practical emulsions.

Comments

Milk proteins are discussed under the following headings:
Derivation and general properties of edible milk proteins; Sources of supply; History of milk proteins in the food industry; Applications of milk protein in the food industry including function considerations; Nutritional aspects; Costs; Flavour; High protein whey preparation.

In this review the author discusses the use of whey, skimmilk, casein, and caseinates in food stuffs such as bread, protein-enriched milk products, milk biscuits, ice cream, pasta, dietetic products with high protein but low fat and carbohydrate content, meatproducts, processed cheese and instant desserts. (27 ref.)

Report from an investigation of the water binding capability of milk protein.

The paper deals with milk proteins and particularly with casein and caseinates, presenting aspects on their stabilizing effect, taste, and use in practical emulsions and foams. Tables are given presenting typical analysis of milk protein products and functional applications of caseinates in the food industry.
Maga, J.A. et al.
Flavour quality of various grain flours and oilseed, milk, and marine protein supplements.

O'Malley, C.M.

Peri, C. & Pompei, C.
Concentration and purification of milk and whey proteins by ultrafiltration and diafiltration.
Lebensm.-Wiss. u. Techn. 6(1973):4, p. 133-137.

Pompei, C. et al.
Skim milk protein recovery and purification by ultrafiltration. Influence of temperature on permeation rate and retention.

Schultz, M.E.
Development of protein-enriched food, dishes and drinks with reference to covering the need for protein in human nutrition.
Milchwissenschaft 27(1972):3, p. 137-142 (Ge.)

Thomas, M.A. et al.
Evaluation of some non-meat proteins for use in sausage.

Comments

Different combinations of ultrafiltration and diafiltration were compared for the production of protein concentrates.

Ultrafiltration experiments were carried out on pasteurized skim milk at 5 and 50°C, using a pilot plant with a tubular membrane configuration. It is concluded that the operation is more economical and more effective on protein purification when carried out at 50°C.

In order to determine the effect of protein additives on the physical properties of the sausage emulsions and on their sensory qualities, fresh sausages were made having various amounts of the meat protein replaced with milk co-precipitates, soy protein preparations or sodium caseinate.
2. Caseins

Cooperative Condensfabriek Friesland.
Edible protein fibres based on casein, and method of manufacture.
Netherlands Pat. Appl. 7.116.966 (1973)
(From Food Sci. & Techn. Abstr. 6(1974):3, S232)

Pfister, B.
Hydrolyzed casein and soybean protein for foods.

Snow Brand Milk Products Co. Ltd.
Synthetic meat product

Comments

A meat substitute having a chewy consistency contains protein fibres produced by extrusion of a viscous solution of a caseinate complex through a spinneret.

The protein hydrolyzates, useful for foods, were prepared by refluxing a mixture of H$_2$O 62 parts, 34% HCl 92 parts, for 18-20 hr and protein 70 parts, cooling to 28-32°C, adjusting the pH to 6.5-6.7 with 105-115 parts 30% NaOH, cooling to 15-20°C, filtration and drying.

An alkaline solution of soybean protein or milk casein is mixed with egg white and aged for up to 3 days. This composition is then extruded into an aqueous acid bath.
3. Whey

Alikonis, J.J.
Whey solids increasing use
in confections.
Proceedings from
Whey Products Conference,
Chicago, Illinois, June 14-15,
1972.
Eastern Regional Research
Laboratory Publ. No. 3779
(1973), p. 57-60.

American Home Products Corp.
High-protein, calcium form
of desalted whey.
Brit. Patent 1,306,402
(1973).
(From Chem. Abstr. 78(1973):21,
134728.)

Anon.
Orange juice and cheese
drink.
Citrus and Vegetable Magazine
(From Food Sci. & Techn.
Abstr. 6(1974):2, H261.)

Berlin, E. et al.
Water binding in whey protein
concentrates.
J. Dairy Sci. 56(1973):8,
p. 984-987.
(From Chem. Abstr. 79(1973):13,
77110).

Cerbulis, J.
Application of Steffen process
and its modifications to re-
covery of lactose and protein
from whey.
J. Agr. Food Chem. 21(1973):2,
p. 255-257.

Comments

The paper gives a short survey of
the possibility of using whey in
confections.

The whey was prepared by concg.
cheese whey at 158-161°F in vacuo
until the solids were 24.8% (wt),
desalting the conc. by electrodia-
lysis or ion exchange until the
ash content was 0.4-0.8% and the Ca
content 0.12-0.20 %, evapg. the
desalted product at 120-40°F in
vacuo to 40% solids, sepg. the ppt.,
adjusting the pH of the liq. portion
to 6.5-7.0 with Ca(OH)₂, concg. the
liq. at 130-140°F, and drying the
solid.

The development of a beverage con-
taining cheese whey and orange
drink is discussed.

The Steffen process, which utilizes
CaO for precipitation of sucrose
in molasses, was applied to the
recovery of lactose from whey. A
combination of CaO treatment with
acetone usually precipitated 94-
99.5% of lactose and 82% of
total N from solution; methanol
precipitated more N but less lac-
tose from whey.
Cox, A.C.
Whey powder.
Food Process. Ind.

Delaney, R.A.M. et al.
Manufacture of undenatured whey protein concentrates
by ultrafiltration and
spray drying. II Medium-
protein powders.
(From Food Sci. & Tech. 
Abstr. 6(1974):1, p.70

Groves, F.
An economic analysis of
whey utilization.
Proceedings from Whey 
Products Conference,
Chicago, Illinois,
Eastern Regional Research
Laboratory Publ. No. 3779 

Guy, E.J.
Use of whey in baking.
Proceedings from Whey 
Products Conference,
Chicago, Illinois, June
Eastern Regional Research
Laboratory, Publ. No. 3779 
(1973) p. 34-42.

Holsinger, V.H.
The use of cheese whey in
beverages.
Proceedings from Whey 
Products Conference,
Chicago, Illinois, June 
Eastern Regional Research
Laboratory Publ. No. 3779

Comments

The nutritive value, functional
benefits and the uses of whey in
bakery goods, confections and ice
cream are considered.

A process is described for producing
a whey protein concentrate.

The paper deals with the following
subjects: Importance of whey in
Wisconsin; Disposal methods; Change
in disposal methods; Whey processing;
Whey marketing; Whey prices and the
future for whey.

The author presents results from an
investigation where some of the
nonfat dry milk used in baked goods
is replaced by blends of nonfat dry
milk and whey. Various effects of
this replacement are presented, such
as: Effect on dough absorption and
mixing time, effect of heat process-
ing of cottage cheese whey on bread
quality, effect of lactose on bread
volume, effect of whey protein con-
centrates on baking quality. In con-
clusion he found that wheys, even if
high-temperature treated tend to
decrease bread-baking quality by
increasing dough mixing time lowering
of water absorption and a depression
of bread volume. Suggestions are,
however, given how to avoid these
changes.

The author presents results from an
investigation on the use of protein
isolated from cottage cheese whey
for soft drink manufacture. From
observations presented and from
data obtained in ongoing observa-
tions she believes that whey proteins
can be successfully used to fortify
most soft drinks if they can be con-
centrated undenatured at a reason-
able price.
Hoisinger, V.H. et al.
Fortifying soft drinks with cheese whey protein.

Horton, B.S. & Kirkpatrick, K.J.
Whey processing progress in other countries.
Eastern Regional Research Laboratory. Publ. No. 3779(1973) p. 130-139.

Jacobsen, D.H.
Use of modified whey products and lactose in food industry.
Amer. Dairy Res. 36(1974):1, p. 34.

Lindquist, L.O. & Williams, K.W.
Aspects of whey processing by gel filtration.
(From Food Sci. & Techn. Abstr. 6(1974):1, P 71)

Mavropoulou, I.P. & Kosikowski, F.V.
Composition, solubility, and stability of whey powders.

Mavropoulou, I.P. & Kosikowski, F.V.
Free amino acids and soluble peptides of whey powders.

Mayer, B.M. et al.
Bakery additive comprising a mixture of whey proteins with a dried lactose-consuming yeast.
U.S. Patent 3,737,327(1973)
(From Chem. Abstr. 79(1973):7, 41165)

Comments

The paper presents progress in the processing of whey from several countries such as: Oceanian & Japan, New Zealand, North and South America, Western Europe and Eastern Europe.

The Sephamatic system developed by Pharmacia Fine Chemicals for industrial gel filtration is described together with production parameters.

Eight samples of acid and three of sweet whey powders from different geographical locations were analyzed for general and amino acid composition.

Four acid and three sweet whey powders were analysed for free amino acids and soluble peptides.
McDonough, F.E.
Report on USDA- H.P. Hood
Contract Proceedings from
Whey Products Conference,
Chicago, Illinois, June
Eastern Regional Research
Laboratory. Publ. No. 3779
(1973) p. 119-126.

Meade, R.E.
Miscellaneous human food
uses for whey products.
Proceedings from Whey
Products Conference,
Chicago, Illinois, June
Eastern Regional Research
Laboratory Publ. No.

Meggle, J. et al.
Protein concentrate from
whey.
British Patent 1,313,085
(1973)
(From Chem. Abstr. 79(1973):3,
17228)

Meggle, J.A.
Process for obtaining a
protein concentrate from
whey.
British Patent 1,313,685
(1972)

Morr, C.V.
Some functional properties
of whey proteins.
Proceedings from Whey
Products Conference,
Chicago, Illinois, June
Eastern Regional Research
Laboratory. Publ. No.

Comments

The paper presents results from an
investigation on the evaluation of
commercial-scale processing of
cottage cheese whey by reverse-
osmosis/ultrafiltration including
operational problems and conclu-
sions.

The paper covers the food uses for
whey products except the most usual
ones. A list of 34 references is
included.

A process for the production of a
whey protein concentrate involves
adjusting the pH value of the whey
to below the iso-electric point of
whey proteins by the addition of
acids, ion-exchange, electro-
dialysis, or biologically, ultra-
filtration and heating at 70-75°C
before and at >88°C after the ultra-
filtration.

The paper presents results from a
comparative investigation of approxi-
mately 20 different whey protein
concentrates obtained from major
commercial suppliers and from uni-
versity and government scientists
The results presented are: compo-
sition, elemental analysis, avail-
able lysine content, initial pH
and solubility, solubility and
apparent denaturation of whey pro-
teins, polyacrylamide gel electrophoresis (PAGE) patterns and emulsi-
fication and whipping properties.
Comments

Morr, C.V. et al.
Functional characteristics of whey protein concentrates.

Nelson, F.E. et al.
Whey utilization in fruit-flavored drinks.
(From Food Sci. & Techn. Abstr. 6(1974):3, p. 397.)

Pallansch, M.J.

The production of acid whey is discussed together with the influence of various parameters such as, preheating time-temperature, effect of total solids content on the viscosity of cottage cheese whey concentrates allowed to stand at 30-40°C, effect of stirring rate on the increase in viscosity with time of cottage cheese whey concentrates at 63% total solids at 38°C. Various types of drying systems such as Niro, Pillsbury and DeLaval are discussed.

Pallansch, M.J.
Production and utilization of whey protein concentrates.

Reesen, L. et al.
New considerations on complete utilization of whey.

Richert, S.H. et al.
Effect of heat and other factors upon foaming properties of whey protein concentrates.

Romans'ka, N.M. et al.
Manufacture of a beverage from whey.
(From Food Sci. & Techn. Abstr. 6(1974):1, p. 33)

Results are presented from a study undertaken to investigate the effects of heat treatments, pH levels, calcium concentration, redoxpotential and sodium lauryl sulfate upon foaming properties of WPC.

A procedure for production of non-alcoholic beverage is described.
Senter, S.D. et al.
Fluorometric determination
of sulfhydryl and disulfide
groups in whey from milk
processed by turbulent flow
ultra-high temperature
process.
J. Dairy Sci. 56(1973):10,
p. 1331-1336.

Singleton A.D.
Whey usage in dairy products.
Proceedings from Whey
Products Conference,
Chicago, Illinois. June
Eastern Regional Research
Laboratory
Publ. No. 3779(1973),
p. 52-56.

True, L.C. et al.
Utilization of acid whey as
a base for salad dressings.
Cultured Dairy Products J.
(From Food Sci. & Techn.

Vajdi, M. et al.
The feasibility of whey
utilization for the pro-
duction of various drinks.
Modern Dairy 52(1973):3,
p. 14-16.

Zall, R.R. & Goldstein, D.J.
Membrane processing of
cottage cheese whey.
Proceedings from Whey
Products Conference,
Chicago, Illinois, June
Eastern Regional Research
Laboratory. Publ. No.

Four different salad dressings were
tested with various formulations.

A general discussion of membrane
processing and observations from
a plant in operation are presented.
4. Co-precipitates

Chojnowski, W. et al.
The production and composition of a soluble milk-protein meal.

Lowenstein, M. et al.
Preparation and growth producing evaluation of a concentrated coprecipitate of soy-cheese whey protein.

Comments

A method using all proteins in the milk in a production of sodium proteinate. The product has a NPU-value of 72-74.
5. Blood and other by products from the food industry

Grant, R.A.
Protein Recovery from process effluents using Ion-exchange resins.

Halliday, D.A.
Blood - A sauce of proteins.

Hopwood, A.P. & Rosen, G.D.
Protein and fat recovery from effluents.

Melikjan, H.
The use of a valuable protein raw material - blood.

Toledo, R.T.
Preparation and properties of low temperature extracted animal protein concentrates.

Comments

A process has been developed which permits the separate recovery of protein and fat from meat, poultry and other food processing effluents, while at the same time achieving a large reduction in the BOD level. The process uses a recently developed ion-exchange resin capable of adsorbing proteins and other macromolecules.

A process is described which separates water-insoluble solids, including fat, or insoluble solids plus freshly co-precipitated protein plus fat, by flotation after chemical precipitation. Plants are in operation. Economic aspects are also covered.

A general discussion of the use of blood in East Europe and reporting from investigations in the Soviet Union that the addition of blood serum to sausage products does not influence taste and aroma.
D. OILSEED PROTEINS

1. Discussions of and comparisons between different oilseed proteins.

Anon.

Arnould, J.-P.

Dunning, H.N. et al.

El-Nockrashy, A.S.

Fleming, S.E. et al.

Comments

Product description, processing technique, recommended chemical composition, sanitary considerations, and toxicological considerations are given for milk substitutes and vegetable-toned milk containing soybean and/or peanut protein.

Production, import and export of soybeans and other oilseeds are summarized for the period 1960-1970.

The apparatus consists of a cylinder. The protein material is subjected to a steam flow when it is passing through the cylinder. The outlet opening is varied in response to the pressure in the cylinder. The protein material may be defatted oilseed meals and flours.

Actual and potential availabilities of oilseeds and oilseed proteins are given. Work on protein concentrates and protein isolates of soybean, cottonseed, and peanuts are reported. Problems of utilisation of oilseeds and attempts made for preparation of products suitable for human consumption are explained.

The objectives of the study were to compare the water absorption and viscosity characteristics of untreated and pH-activated slurries of sunflower flour, concentrates and isolates with soyflour, concentrates and isolates at room temperature and during a heating and cooling cycle.
Gubler, D.  
Vegetable proteins in meat-based products.  

Mattil, K.M.  
Considerations for choosing the right plant protein.  

Comments

A review of the manufacturing procedures for powdered, textured, and structured meat-based products with soybeans or other vegetable proteins.

A general discussion of the possibilities for food manufacturers to choose different types of proteins for their products today and in the future.
2. Soy proteins

2.1. Reviews

Baldwin, A.R.
Summary of the World Soy Protein Conference.

Coppoc, J.
Soy proteins in foods - retrospect and prospect.

Kárpáti, G.
Utilization of various soy products in the production of foods.
Élelm. Ipar 27(1973):10, p. 294-303 (Hu.)

Melnychyn, P. (ed.)
Soy: the wonder bean
Proceedings of a symposium sponsored by the American Association of Cereal Chemists.

Rosen, G.D.
Status of certain specialty soya derivatives in the U.S.A. Part I,

Rosen, G.D.
Progress report on the status of certain specialty soya derivatives in the USA.
Part II,

Rosen, G.D.
Current status of specialty soya protein products in the USA. Part III,

Comments

The World Soy Protein Conference in Munich 11-14 Nov. 1973 is summarized with very short reviews of speeches given.

Technical, nutritional, economical, and political prospects of soy proteins are discussed.

A literature review about the possibilities of utilization of various soy products.

The papers in the symposium dealt with cultivation, processing, use, upgrading biological properties, and toxicity of soybeans and soybean products.

Manufacturers and products estimated market quantities, uses, food and drug administration aspects, research and development activities and applicability to European conditions of soy protein concentrates and isolates are discussed.

Updating of the above mentioned report.

Progress in nutritive value, functional properties and in milk and meat substitutes, is assessed from the point of view of use practices, pricing, market volumes, legislation and research and development.
Wolf, W.J.
Soybean proteins: Their production, properties, and food uses. A selected bibliography.

Comments
118 key references are given for providing an introduction to production, properties, and food uses of soybean proteins.
2.2. Treatments of soyproteins with heat or enzymes

**Comments**

A method is described for preparing a methionine-enriched plastein on a practical scale. Its amino acid composition is compared to that of a soy bean protein preparation used as a starting material.

The authors conclude that the plastein reaction involves a peptide-chain elongation process without any appreciable S-S bridge formation. The water insolubility of the plastein is said to be a result of hydrophobic bonding.

Changes on the digestibility of soy protein and the formation of coloured products after addition of saccharides to soy protein were studied.

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Arai, S. et al.

Aso, K. et al.

Janicek, G. et al.

2.3. Functional properties


Comments

A review of the production of soybean products, their economics, their usefulness as supplements, extenders and replacements in meat, dairy and cereal foods vs. animal-derived protein.

Chemical composition, water binding capacity and emulsifying capacity of some commercial soy protein preparations and yeasts were examined.

The authors conclude that:
1) Soy and yeast proteins have a favourable influence on the emulsifying capacity of meat proteins.
2) Emulsions of extracted proteins of meat and tallow with added soy proteins only become stable after heating at 70°C for one hour.
3) Soy and yeast proteins, in contrast to M. longissimus dorsi, have considerably higher contents of total and extractable nitrogen and lower contents of water and fat.

The min. solubility of proteins at various pH values is determined by measurement of absorbance value at 280 nm of non-precipitated proteins.

Solutions of powdered soybean proteins were canned and sterilized for 30-40 min. at 80-120°C. The protein were then submitted to texturometer or penetrometer tests.
2.4. Flavour

Cowan, J.C. et al.
Soybean protein flavor component: a review.

Gremlis, H.A.
Interaction of flavor compounds with soy protein.

Janicek, G. et al.
Debittering of soybean flour by alcohol vapour. I. Evaluation of the debittering effect by means of the determination of activities of some soybean enzymes and of the Fröhlich test.

Maga, J.A.
A review of flavor investigations associated with the soy products raw soy beans, defatted flakes and flours, and isolates.

Markh, A.T. & Vinnikova, L.G.
Volatile components of protein hydrolysates from soy beans.

Comments
This is a review dealing with studies on:
1) Sensory evaluations of commercial soy flours, concentrates and isolates.
2) Extraction of flavor components from soybean flakes with hexane-alcohol mixtures.
3) The application of proteolytic enzymes to improve flavor.
4) The effect of inactivating lipoxygenase on soy beverage flavour.

The author describes a method which can be used to determine whether a flavor compound reacts reversibly or irreversibly with soy proteins.

The debittering of soybean flour by a mixture of alcohol and water is more rapid than debittering by water or alcohol alone. The debittering of material for food use may be carried out by ethanol, the optimum concentration being 10%.

A literature review of work that has been done on the soy flavour problem.

Regardless of the method of hydrolysis used (acidic or enzymic) products of the sugar-amine reaction (furfural, hydroxymethylfurufurol, furfuryl alcohol and maltol) were the most important contributors to the flavour of the hydrolysate.
2.5. Soy flours, concentrates, and isolates

Comments

In the described process commercial soy flour is treated to yield 90% protein superconcentrate and 30% soy flour.

Soybean flakes are treated with 0.5-4% by weight of a polysaccharide (CM-cellulose, guar gum, Na alginate, carrageenan, gum karaga, alginic acid, or agar) in an excess of water at pH 4.2-4.6 and 20-50°C for 0.5-2 hr. The insoluble fraction is then recovered.

Samples of soya bean flour were tested for protein quality and trypsin inhibitor activity.

Composition, nutritional value, functionality, and applications of defatted soy flours and grits are discussed.

Manufacturing procedures of full-fat soy flour is described together with nutritional and functional qualities.

The use of soy protein products in some meat systems is described and guidelines are presented to optimize their use.

Bernadini, E. & Bernadini, M.
Industrial equipments for production of protein superconcentrates to start from proteinic meals.

DeLapp, D.F.
Soy protein concentrate.
U.S. Patent 3 762 929 (1973)

Holm, H. et al.
Chemical and biological evaluation of protein quality of locally produced and processed full-fat soybean flour from Three Tanzanian Villages.

Kelor, R.L.
Defatted soy flours and grits.

Pringle, W.
Full-fat soy flour.
J. Am. Oil Chemists' Soc. 51(1974):1, p. 74A-76A.

Rakosky, J.
Soy grits, flours, concentrates, and isolates in meat products.
2.6. Textured soy proteins

Anon.
USDA proposes rules on use of TVP in meat products.

Conway, H.F. & Anderson, R.A.
Protein-fortified extruded food products.

Giddley, C. & Ruger, W.
Soy bean protein-containing cellular food product.
Fr. patent 2 113 296 (1972)

Hamdy, M.M.
Nutritional aspects in textural soy proteins.

Holmes, A.W.
Artificial or substitute meats and the uses of soya protein.

Iles, B.C. & Elson, C.R.
Textured protein products - A textural investigation.

Korslund, M. et al.
Comparison of the protein nutritional value of TVP, methionine-enriched TVP, and beef for adolescent boys.

Comments

USDA’s proposal contained definitions of TVP and placed rules on how the protein could be used and how it should be labelled.

Extruded mixtures of a cereal product and one or two high-protein products (defatted soy flakes, defatted soy flour, soy concentrate, soy isolate or wheat gluten) were analysed for fat, protein, expansion, water absorption and water solubility.

A paste of soybean protein and H2O at pH 5.9-7 is heated by increasing the temperature by 10°C/sec. to 100-140°C to coagulate the protein and to eliminate H2O to 5-20% by weight.

The author claims that numerous feeding tests with people and experimental animals show that the biological values of textured soy proteins are high and that protein efficiency ratios compare favorably with pure meat products.

The author discusses the future, the manufacturing, the use, the eating quality and the legal aspects of artificial meats.

Tenderness and juiciness of extruded and spun protein products, that had been rehydrated and cooked, were investigated by the aid of an Instron Universal Testing Machine.

The nitrogen balances of nine boys, 12-16 years old, were studied. The results indicated that the protein qualities of soy bean-containing products are somewhat lower than those of high quality animal products.
Rosenfield, D. & Hartman, W.E. 
Spun-fiber textured products 

Trumic, Z. & Polic, M. 
Hydration of TVP in water and in sodium chloride solutions and its effect on some chemical and physicochemical properties of hydrated samples. 

Turk, R.E. et al. 
Adequacy of spun-soy bean protein containing egg albumen for human nutrition. 

Wilding, M.D. 
Textured proteins in meats and meat-like products. 

Wolford, K.M. 
Beef/soy: Consumer acceptance. 

Comments

The process for spinning fibres and the fabrication of analogues and extenders containing these fibres are described. Nutritional properties are discussed.

The examinations covered quantitave determinations of moisture, proteins, fats, sugar, ash, NaCl and cellulose. The physicochemical determinations included the content of free and bound water, pH, and calorific value.

Nitrogen balance studies were conducted on 5 young adults and 3 teenagers during 5 consecutive 1-week periods in which spun soy bean protein constituted the principal source of dietary nitrogen.

Effects on functionality, nutritional quality, bacteriology and colour after addition of textured proteins to meat-systems are discussed.

The processing and introduction on the U.S. retail market of a red meat/textured vegetable blend is briefly described.
Bressani, R. et al.
Whole soy beans as a means of increasing protein and calories in maize-based diets.

Chabrowski, K. et al.
Use of soy protein preparations to increase the nutritive value of bread.

Cotton, R.H.
Soy products in bakery goods.

Graham, G.G. & Baertl, J.M.
Nutritional effectiveness of soy cereal foods in undernourished infants.

Jakubczyk, T. et al.
Effect of selected preparations of soy bean protein on wheat bread quality.

Jakubczyk, T. & Haberowa, H.
Soy flour in European-type bread.
J. Am. Oil Chemists' Soc. 51(1974):1, p. 120A-122A.

Pomeranz, Y. & Finney, K.F.
Glycolipids, key to protein-enriched bread.

Comments

Studies were carried out to improve the protein quality and the calorie content of tortillas made by mixing soy beans and maize. The authors suggest that a mixture of 72% maize and 28% whole soy beans would be a good-quality food for small children.

A protein preparation was made by aqueous extraction at pH 9 and 7.2 of a soy meal followed by precipitation at the isoelectric point, dispersion as sodium proteinate and spray-drying.

Applications of soy proteins in baking are reviewed and data on taste and texture tests are presented.

The effect of various cereal foods containing soy proteins on growing infants and children was studied.

Five different types of Central Soya's preparations were tested with respect to bread volume, kneading time, CO₂ formation, taste, and colour.

Effect of soy flour, soy protein concentrate and soy isolate on dough and loaf properties of breads produced from flour, yeast, salt, and water with no shortening or added improvers were investigated.

By adding high levels of protein supplements plus glycolipids, it is possible to maintain consumer acceptance of enriched bread with protein content increased by about 70%.
Seibel, W.
Use of protein preparations in the manufacturing of breads.
Gordian 74(1974):3, p. 95-97, (Germ.)

Tsen, C.C. et al.
High-protein cookies.
I. Effect of soy fortification and surfactants.
Baker's Dig. 47(1973):4, p. 34, 36-39.

Turro, E. & Sipos, E.
Special soy protein product for bread baking.

Comments

The protein content of bread can be increased by addition of soya or milk proteins. Dough mixing, dough processing, and baking time must then be adapted to the protein preparations or to the formulation used.

The influence of additions of soy flours, soy isolate, sodium stearoyl-2-lactylate, and sodium stearoyl fumarate to wheat flours have been investigated by measurements of the width and height of baked cookies.

An improved processed soybean flour protein product was produced by the use of Ca lactate as a buffer, CaSO4 as a water conditioner, and ascorbic acid as a reducing agent.
2.8. Soy proteins in meat and fish

Cantoni, C.A. et al.
Soy bean proteins and meat products.
Review and experimental results.

Coomaraswamy, M. & Flint, F.O.
The histochemical detection of soya 'novel proteins' in comminuted meat products.

Frouin, A. et al.
Detection of soy bean and milk proteins in sterilized and unsterilized meat products.
(Fr.)

Ishikawa, S. et al.
Studies on fish sausage with vegetable protein. II Relation between the physical properties and the organoleptic test of fish sausage.

Judge, M.D. et al.
Soya additives in beef patties.

Comments

Experiments were carried out in which soy protein was incorporated into various types of foods such as pasta fillings, rissoles, fried vegetable dishes and minestrone. Results showed that in most cases the dishes made with soy protein had a higher or similar protein content than the same dishes without soy protein and that organoleptic qualities were not affected.

Samples are sectioned, oxidized in periodic acid, treated with Schiff's reagent, and counterstained for protein. Carbohydrate material appears magenta in the microscope, while protein appears blue or green.

Disc gel electrophoresis detected ≥ 0.1% admixtures of milk or soy bean protein in meat products. This method was more sensitive with unsterilized than with sterilized meat products.

Physical properties (lightness, jelly strength and hardness) of 18 kinds of fish sausages, in which parts of the fish were substituted by wheat or soy proteins, were measured.

The influence on some quality parameters of the addition of 2 and 6% soy flour and soy concentrate to meat patties containing two fat levels (20 resp. 30%) were studied. The quality parameters investigated were: number of bacteria, brightness of colour, cooking shrinkage and a "paper release test".
Mize, J.J.
Factors affecting meat purchases and consumer acceptance of ground beef at three fat levels with and without soya-bits.

Nakamura, K. et al.
Studies on fish sausage with vegetable protein. I. Results of the organoleptic test and the chemical analysis of fish sausage.
(Ja.)

Sangor, M.R. & Pratt, D.E.
Lipid oxidation and fatty acid changes in beef combined with vegetables and textured vegetable protein.

Comments
Samples of ground beef with an additional 15% of fat received higher mean scores for all palatability characteristics measured. The presence of soya-bits in all three levels of added fat (15, 25 and 35%) generally increased the mean scores of the ground beef samples.

Organoleptic tests and chemical analyses were performed on 18 kinds of fish sausages, in which parts of the fish were substituted by wheat or soy proteins.

The authors studied the protective effect soy textured protein had on the lipids of a food system when used as a supplement to beef.
2.9. Soy proteins in beverages

McCabe, E.M.
Soluble soy bean protein for alcohol-free beverages.
W. Germ. Patent. 2229262 (1973)

Mustakas, G.C.
A new soy lipid-protein concentrate for beverages.

Comments

Soy bean protein was dissolved in aq. NaOH at pH 8.0. HCl was added to adjust the pH to 6.0. After addition of a phytase preparation and 24 hr incubation at 50-55°C the precipitate obtained by adjusting pH to 4.6 was separated. The pH of the supernatant was elevated to 5.2, and the precipitate washed and dried to give a white powder.

A lipid-protein concentrate (LPC) was isolated from full-fat soy flour by isoelectric precipitation at pH 3.5. The LPC was heat-treated to inactivate lipoxigenase and growth inhibitors. After wet-milling and homogenizing the product had excellent suspension properties in water.
2.10. Soy proteins in nutritional aid programs

Higgins, M.
Soy products in national and international programs: field and emergency programs.

Hutton, G.H.W.
International programs utilizing soy foods: the World Food Program.

McCloud, J.T.
Soy protein in school feeding programs.

Parman, G.K.
Agency for International Development's program for development and utilization of soybeans in the developing world.

Senti, P.R.
Soy protein foods in U.S. assistance programs.

Comments

The acceptance and popularization of soy-fortified foods is discussed.

The use of such soy food products as corn-soy milk and wheat-soy blends in WFP aid programs is described.

The use of textured soy protein in the school feeding program in Memphis, USA is described.

The department of State's Agency for Industrial Development in USA is sponsoring a development program to increase yield and utilization of soy beans in tropical and subtropical countries.

The use of soy protein food product for as well overseas as domestic food assistance programs is discussed.
2.11. Nutritional and toxicological aspects on soy proteins

Clark, R.W. et al.
Distribution of a trypsin inhibitor variant in seed proteins of soy bean varieties.

Engrand, M. & Duterte, R.
Alimentary uses of soy bean flours as a function of their protein value.

Fomon, S.J. et al.
Infant protein needs provided by a soy-based formula.

Hori, M. & Miyazaki, M.
Trypsin inhibitor alteration in the process of treatment of soy beans. I. Trypsin inhibitor contents of soy beans, other beans, and soy products.

Hori, M. & Miyazaki, M.
Trypsin inhibitor alteration in the process of treatment of soy beans. II. Trypsin inhibitor reduction and irradiation of soy bean.

Kakade, M.L. et al.
Contribution of trypsin inhibitors to the deleterious effects of unheated soy beans fed to rats.

Comments

The frequency of a trypsin inhibitor variant in soy bean varieties grown in USA was determined.

A review is given on the titled subject, including limitations such as trypsin inhibitor and nondigestible carbohydrate which are both present in soy beans.

The authors conclude that the protein requirements of normal female infants are no greater than 1.62 g protein per 100 kcal and that infants fed on a soy-isolate formula containing this amount of protein grow as well as infants fed on the breast or with a milk-based formula of similar protein content.

Trypsin inhibitor of soy beans and soy products was determined using a colorimetric method. Soy beans contained 0.5-0.9 mg trypsin inhibitor per mg N.

When a solution extracted from soy beans was heated at 100°C for 1 hr. 16% of the original trypsin inhibitor remained. Irradiation by β-rays reduced this level by 50%.

The extent to which trypsin inhibitors are responsible for the poor nutritive value of unheated soy beans was studied by selectively removing the trypsin inhibitors from an extract of raw soy bean flour and comparing the results of rat feeding tests using diets containing the treated and untreated extracts.
Kárpáti, G.
Chemical-nutritional physiological evaluation of a few products manufactured with the use of soy protein.

Rackis, J.J.
Biological and physiological factors in soy beans.

Comments
The author claims that soy protein can be used in large quantities to increase the protein content and the nutritive biological value of traditional Hungarian products.

In this review with 218 references the following subjects are discussed: 1) Biological factors in soy protein products; 2) Elimination of antinutritional factors; 3) Interrelationships between antinutritional factors; 4) Proteinase inhibitors; 5) Phytchemagglutinins; 6) Antivitamin and mineral factors; 7) Allergenicity; and 8) Flatulence.
2.12. Economical aspects

Anon.  
Consumer acceptance of vegetable protein .... expands opportunities at supermarket level.  

Butz, E.L.  
World protein markets - a supplier's view.  

Dovring, F.  
Soy beans.  

Fischer, R.W.  
Future of soy protein foods in the market place.  

Houck, J.P. et al.  

Comments

The marketing of beef/soy protein blends in USA is briefly discussed. A list of soy protein producers that can give information on formula methods of protein addition and flavor improvement for meat/soy protein combinations is given.

The use of textured vegetable proteins in different food items of the USA and countries in some developing areas is discussed. Tariff treatments of soy proteins especially in the EEC are also mentioned.

The role of soy beans as a means of balancing import payments to the USA is discussed.

A rough estimation is given for the future protein commodity market.

The book is divided into three sections: 1) a brief look at the foreign and domestic (U.S.) soy bean market; 2) a discussion of the development and use of an aggregate dynamic supply and demand model of postwar markets for U.S. soy beans and products; 3) an examination of foreign markets for U.S. soy beans and products.
2.13. Juridical aspects

Czarnecki, J.N.
Position of soy protein processors in relation to laws and regulations.

Esposito, L. & Maranelli, A.
Use of soya flour in some types of sausage and in canned meats. Juridical aspects.

Mussman, H.C.
Regulations governing the use of soy protein in meat and poultry products in the U.S.

Ward, A.G.
The U.K. legislative approach to the use of soy proteins in food.

Watanabe, T.
Government role and participation in development and marketing of soy protein foods.

Winkelstern, H.
Addition of soya flour to meat products?
Fleischwirtschaft 53(1973):7, p. 941-943. (Ge.)

Wodicka, V.O.
Authorizations and restrictions on soy protein in foods in the U.S.

Comments

The difficulties that arise for the processors in USA, where several regulations exist regarding the use of soy proteins, are discussed.

30 samples of different sausages and canned meats were analysed for non-meat proteins. In 13 of the samples traces of soy proteins were found. The legal position of an addition of soy proteins in Italy is discussed.

The approaches of regulations of soy bean products undertaken by USDA is discussed.

A brief review regarding the use of soy products in foods in the light of current U.K. laws, U.K. consumer need, and areas of U.K. law where proposals to cope with new processes and products might be brought forward in the near future.

The use of soy bean foods and governmental aspects of using soy beans in Japan are discussed.

The question whether or not soy meal is permitted to be used in minced meat foods according to West German law is discussed.

The development of regulations for soy bean products undertaken by FDA is discussed.
2.14. Miscellaneous

Anon.
Why the world is short of soy beans.
Food Eng. 46(1974):4, p. 2C, 2D, 2F.

Balla, F.
Nutritional value and economic aspects of fortification of foods of plant origin with soy protein.

Blair, G.T.
Further product applications for textured vegetable proteins.

Chone, E.
The cultivation of soya in France: Future developments.

Engrand, M. & Duterte, R.
Nutritive use of soy flours as a function of their protein value.

Frazeur, D.R. & Huston, R.B.
Soy bean protein.

Gerhardt, U.
Soya: A valuable oil- and protein plant.

Comments

The shortage of soy beans during 1972-1973 is attributed to unfavourable harvest weather in USA, drought in India, Peruvian fish meal shortage, and bad quality of the crop harvested in 1972.

The protein requirements of children and adults are reviewed in comparison with the protein qualities of several foods with and without added soy.

The use of textured vegetable (soy) protein together with red meat, poultry, seafood and dairy products are discussed.

A continuing study commenced in 1966 is reviewed. This study comprises a variety of experimentation and research about three cultural techniques: inoculation, irrigation and use of insecticides.

The evaluation of nutritive and functional properties are described including determination of low content trypsin inhibitor and determination of remaining hull constituents in the flour.

Protein material containing < 25% denatured proteins were manufactured from aq. suspensions of defatted soy bean protein by filtration of H2O-insoluble components and reverse osmosis of the liquid.

The article gives a general description of the biology, cultivation and upgrading of soy beans.
Greuell, E.H.M.  
Some aspects of research in the application of soy proteins in foods.  
J. Am. Oil Chemists' Soc.  
51(1974):1, p. 98A-100A.

Han, D.S.  
Soy bean protein estimation by a modified dye-binding method.  
Kangwon Tachak Yon'gu Nonmunjip 6(1972), p. 45-54.  

Holmberg, S.A.  
Soy beans for cool temperature climates.  
Agri Hortique Genetica.  

Horan, F.E.  
Soy protein products and their production.  
J. Am. Oil Chemists' Soc.  

Ilany, J.  
Soy bean food for today and tomorrow.  

Kadane, V.V.  
The use of soya proteins in the production of non-meat food products in Europe.  
Rev. Techn. de l'Ind. Aliment.  
214(1973):21, p. 29, 31. (Fr.)

Kim, W.J. et al.  
The removal of oligosaccharides from soy beans.  
6(1973):6, p. 201-204.

Comments

Work on soy products at Unilever Laboratories is described. Two off-flavor precursors and several meat flavors have been identified. By studying protein solubility relationships, a new method of concentrating soy proteins has been developed.

A modified dye-binding method for soy bean protein estimation is compared to protein estimation by Kjeldahl. The dye-binding method is recommended for protein estimation when numerous samples are handled and speed is required.

Breeding trials with cold resistant soy bean strains in Sweden are described.

The history of the soy bean and the impact on the economy of USA is sketched out. The processing of soy flour and textured soy proteins is briefly described.

In three articles the author gives a review of soy bean products both home and industrially prepared or processed.

The author examines the reasons why European food industries more and more introduce soy protein into their food products.

A procedure was developed to separate and determine the relative amounts of oligosaccharides in soy beans, the procedure involved soaking, germination and resoaking of the soy beans.


Comments
A new dish containing meat and vegetables has been developed. The meat is partly substituted by a dressing containing soy flour.

This is a presentation of the re-utilization of soy proteins in dairy-type foods, beverages and cereal-type foods.

The soy bean protein was prepared by adjusting the pH of soy bean flakes suspension to 2.0-4.2 then inactivating the trypsin inhibitors by heating under pressure and expansion. The product was used for the manufacturing of acid fruit puddings.

Samples of 8 different commercial concentrates and 11 isolates (all anonymous) were analysed and compared regarding the titled properties.

Kjeldahl and ultracentrifugal analyses were performed on the extracts obtained. The results indicated that the enhanced extractability obtained when adding 2-mercaptoethanol to the extracting medium (water), could be attributed to disruption of water-insoluble forms of disulfide polymers in the soy bean meal.

Short remarks on food legislation regarding soy proteins and short description of typical areas of use are given.
Shindo, K. et al.
Studies on utilization and nutrition of soy beans protein.

Wilcke, H.L.
Future developments in soy protein research and technology.

Wolf, W.J.
Soy bean ultrastructure and its relation to processing.
(Ed. Inglett, G.E.
AVI: Westport, Conn. 1971)

Comments

Description of a process for preparing a soy bean protein curd by coagulating soy bean milk with CaSO₄.

The author discusses the following factors that will primarily influence the future development of soy protein: Acceptability of soy products through flavour and colour, functional characteristics, and processing technology.

A review is given on soy bean ultrastructure and changes in cellular structure during processing.
3. Cottonseed protein

Bush, A.
Low-cost protein from cottonseed.

El-Nokrashy, A.S. et al.
Degossypolisation of cottonseed meal. IV. Effect of cottonseed pigment glands and infraglandular pigments on the lysine availability of cottonseed protein.

Guy, R.C.E. et al.
Analysis of commercial soya additives in meat products.

Hoffpaurir, C.L.
Cottonseed. New food for protein-hungry world.

Hoffpaurir, C.L.
Cottonseed. New food for protein-hungry world.

Lawhon, J.T.
Protein product presents potential as nut ingredient.
Candy and Snack Industry 137(1972):10, p. 34.

Lawhon, J.T. et al.
Recycling of effluent from membrane processing of cottonseed wheys.
Food Techn. 27(1973):2, p. 26-34.

Comments

A general description of the first commercial-scale plant for making food-grade cottonseed protein flour is given.

El-Nokrashy, A.S. et al. (1973) investigated the effects of heat, NH₃ gas and FeSO₄ on the gossypol content of cottonseed pigment glands and on the nutritional value of cottonseed protein. The effects were studied to determine the optimal conditions for processing cottonseed protein.

Guy, R.C.E. et al. (1973) analyzed commercial soya additives in meat products. They found that these additives were effective in improving the nutritional value of meat products, but further studies are needed to optimize their use.

Hoffpaurir, C.L. (1972-1973) explored the potential of cottonseed as a new food for protein-hungry world. The study included the production of a new food product from cottonseed and its potential use in various food formulations.

Hoffpaurir, C.L. (1973) further investigated the potential of cottonseed as a new food for protein-hungry world. The study included the production of a new food product from cottonseed and its potential use in various food formulations.

Lawhon, J.T. (1972) developed a protein product that could be used as a nut ingredient in various food products. The product was tested in candy and snack industry formulations.

Lawhon, J.T. et al. (1973) investigated the recycling of effluent from membrane processing of cottonseed wheys. The study aimed to reduce waste and improve the efficiency of cottonseed processing.

A review is given on the liquid cyclone process for production of edible high-protein cottonseed flour free from the toxic gossypol constituent.

A description of the manufacturing use and toxicity of cottonseed protein products.

Tamunut, a high protein, nut-like product is an edible by-product of cottonseed. It can be used as a nut ingredient in baking and to fortify candy bars.

Whey disposal, a potential problem of food processors isolating protein, was investigated. Results indicate that recycling of reverse osmosis permeate from cottonseed whey is feasible and that this process could be used to prevent water pollution.
Mayorga, H. et al.
Wet concentration process for extraction and precipitation of protein from cottonseed.

Ridlehuber, J.
LCP process-a status report.

Shemer, M. et al.
Effect of processing conditions on isolation of cottonseed protein by sodium hexametaphosphate extraction method.

Velasco, J.
Modified ferric gel method for determining aflatoxin in cottonseed meals.

Comments
Laboratory experiments were conducted to determine the best conditions for extraction and precipitation of protein from cottonseed.

The liquid cyclone process (LCP) for removing gossypol glands from cottonseed is briefly discussed. A report on the construction to date of a LCP plant is given.

The isolate obtained contained 94.8% protein. The nutritive value of the isolate was not significantly different from that of degossypolized cottonseed flour.

The ferric gel method for determining aflatoxin in cottonseed has, with some modifications, been adapted for cottonseed meals.
4. Rapeseed protein

Kodagoda, L.P. et al.
Some functional properties of rapeseed protein isolates and concentrates.

Lanzani, A. & Jacini, G.
Goitrogenic sulphur-containing compounds in rapeseed.

Ohlson, R.
Rapeseed protein concentrate for human consumption.

Owen, D.F.
Detoxification and isolation of rapeseed protein by aqueous saline extraction and isoelectric protein precipitation.
U.S. Patent 3 758 452 (1973)

Schwenke, K.D. et al.
On seed proteins.
The fractional distribution of proteins from rapeseed.
Nahrung 17(1973):5, p. 579-586. (Ge.)

Comments

Protein isolates and concentrates obtained from rapeseed flour by a successive water, HCl, and NaOH extraction process were subjected to baking, emulsification, and whipping tests.

A review of the toxicology, structure and biosynthesis of the thioglukosides present in rapeseed, as well as goitrogenic properties of the breakdown products of these substances.

A short description of processing of RPC at Karlshamn is given. The composition and the nutritive value of the protein is tabulated.

Rapeseed pressing cake was treated with an aqueous extraction medium containing 2-10% NaCl and having a pH of 7.0-8.5. The extraction medium was separated from the press-cake solids and acidified to pH 2.5-3.0 to precipitate the protein while the toxic materials remain in solution.

The different fractions of protein from rapeseed were determined by electrophoresis on polyacrylamide gel and gel-chromatography on Sephadex G-200.
5. Sunflower protein

Delic, I. et al.
Physico-chemical properties of defatted sunflower seed meal and its possible application in the food industry.
Hrana i Ishrana 13(1972):5/6, p. 243-250. (Yu.)

Jerotijevic, S. et al.
A technological procedure for protein concentrate production from sunflower meal.
Hrana i Ishrana 13(1972):5/6, p. 281-284. (Yu.)

Schwenki, K.D. & Raab, B.
On seed proteins. Fractional distribution of proteins from sunflower seeds.
Nahrung 17(1973):3, p. 373-379. (Ge.)

Sirko, V.N. & Buchancov, V.A.
Use of sunflower proteins in bread baking.

Comments

Physical, chemical and biochemical analyses were performed on a sunflower meal containing 48-49% protein.

By mechanical separation of the hulls, which removes fibre and lignins, a grist is obtained having an increased protein conc. By further separation a fraction is obtained having a protein content of 48,5%.

The different fractions of sunflower-protein were determined by the aid of electrophoresis on polyacrylamid gel and chromatography on Sephadex G-200.

The addition to wheat flour of 5-10% of protein concentrate obtained by extraction of sunflower oil cake with 5% NaCl increased the content of essential amino acids in bread without causing any changes in the colour of the crumb and the appearance of the crust. A direct addition of 5-10% of sunflower oil cake to the flour made the bread crumb grey or dark grey.
Miscellaneous proteins

Bortoni, M.H. & Cattaneo, P.
Composition of a protein isolated from whole linseed meal.

Dendy, D.A.V. & Grimwood, B.E.
Coconut processing for the production of coconut oil and coconut protein food and feed products.

Elahi, M. et al.
Milk substitute from groundnuts.
I. Extractability of total solids, fat and protein from groundnut.

Lachance, P.A. & Molina, M.R.
Nutritive value of a fibre-free coconut protein extract obtained by an enzymic-chemical method.

Mackenzie, S.L.
Cultivar differences in proteins of oriental mustard (Brassica juncea (L.) Coss.)

Orlova, L.P. et al.
Amino acid composition of almond, hazelnut, cashew, peanuts, and cakes from them.

Comments

The linseed protein isolate had the following composition:
protein 24%, H₂O 8.1%, and 0.4%, and lipids 0.4%.

A review of existing methods.

A comparison was made between the extractability of total solids, fat and protein of groundnuts with and without Na₂CO₃ pre-treatment.

The fibre-free coconut extract obtained by an enzymic-chemical method proved to have a higher protein nutritive value than that of the original coconut meal. The improvement is attributable in part to the fact that the fibre of unmodified coconut meal has an unfavorable effect on the nutritive value.

The variability in the amino acid composition of the lipid-free meals from the seeds of five cultivars of Brassica juncea has been studied.

In all nuts the principal amino acids were glutamic acid (22-27%), arginine (11-13%), and aspartic acid (8-13%).
Rhee, K.C. et al.  
Effect of processing pH on the properties of peanut protein isolates and oil.  

Saksena, R.K. & Mitra, C.R.  
Fluid-bed separation of enriched protein fraction.  
Indian J. Techn.  

Sambucetti, M.E. et al.  
Isolated protein from linseed meal. I. Nutritive value and toxicological tests.  
Archivos Latinoamericanos de Nutricion 23(1973):1, p. 79-94.

Schwenke, K.D. et al.  
On seed proteins. Isolation and characterization of albumine from sunflower- and rapeseed.  
Nahrung 17(1973):8, p. 79-809. (Ge.)

Valery, N.  
Meatlike product from spun vegetable protein.  

Venkatesan, N. & Roga, D.V.  
Nutritional evaluation of the seed proteins of Calophyllum inophyllum, Linn., and Bassia latifolia.  

Comments

Max. recoveries of protein and oil from raw peanuts were obtained at pH 8.0. The pH during extraction and precipitation of the isolates significantly influenced the viscosity.

A description is given of a simple fluid-bed technique for separating protein-enriched fractions from the non-protein substances present in defatted groundnut meal.

Determinations were made of essential amino acids, net protein utilization, protein efficiency ratio and chemical score. Toxicological tests were performed on rats.

Albumins isolated from sunflower seed and rapeseed extracts by precipitation with ammonium sulphate or tannic acid were electrophoretically and chromatographically investigated.

A spun protein from Vicia faba L is manufactured in Great Britain by Courtaulds.

The possibilities of using the meal remaining after defatting Calophyllum inophyllum, Linn., and Bassia latifolia seeds was investigated using rat growth experiments.
1. Vegetable proteins

Conway, H.F. et al.  
Protein-Fortified Extruded  
Food Products.  
Cereal Sci. Today 18(1973):4,  
p. 94-97

Iacobucci, G.A. et al.  
(Coca Cola Co). Vegetable  
protein products.  
(From Food Sci. d Techn.  
Abstr. 5(1973):10, J 1501)

Kohler, G.O. et al.  
Edible proteins from alfalfa  
and other green leafy plants.  
(From Chem. Abstr. 79(1973):  
9, 52,000).

Miller, D.M. et al.  
Vegetable Protein Concentrates.  

Pion, R.  
Protein and amino acid  
composition of foods of  
vegetable origin.  
Rev. Franc. Dietet.  

Sadre, M. et al.  
Protein Food Mixture for  
Iran.  
60(1972):2, p. 131-134.

2. Leaf proteins

Anon  
Leaf protein new trials.  
Food Process. Ind.  

Betschart, A. et al.  
Extractability and solubi-  
licity of Leaf Protein.  
1, p. 60-65.

Comments

A process is described for preparing vegetable protein products having  
low-phytic acid content by subjecting protein isolates to ultrafiltration  
in the presence of a suitable chemical reagent.

Described is a process for fractionating green leaf vegetable matter pro-  
ducing a protein fraction free of chlorophyll, carotenoids and lipids.  
Other fractions are useful as animal feed.

Mean values are given for individual a.a. in cereals, aleoinous seeds,  
leguminous seeds, roots and tubers, leaves and stems and microorganisms.

A comment on leaf protein and recent research in producing a leaf protein  
concentrate.
Betschart, A.A. & Kinsella, J.E.

Bickoff, E.M. & Kohler, G.O.

Edwards, R.H. et al.

Fremery, D. de et al.

Kroon, S-E.
Leaf protein - food for the human stomach? Köttbranschen 30(1972):4, p. 6-10. (Swe).

Stahmann, M.A.

Comments

Acid (pI) and heat precipitated (h) soybean leaf protein concentrate (LPC) were investigated. There was significantly more isoleucine, leucine, and lysine in LPC h, whereas LPC pI contained more glutamic acid, glycine, and histidine, irrespective of storage time. Methionine, glutamic acid, and tyrosine varied significantly during storage; only tyrosine, however, exhibited a linear trend. Solubility profiles were not influenced by storage.

A wet fractionation process has been developed to obtain an edible white protein from fresh alfalfa. The concentrate contained approximately 90% protein.

In an attempt to prepare alfalfa protein concentrates, the approach has been to develop a method which will separate the soluble white proteins from the insoluble, or particle-bound, coloured protein material.
3. Cereals

Gluskey, J.E. et al.
Oat protein concentrates from a wet-milling process: preparation.

Nielsen, H.C. et al.
Corn germ protein - preliminary studies on preparation and properties.

Nielsen, H.C. et al.
New Corn Protein Isolate - Nutritive, Functional.
Food Eng. 45(1973):4, p. 76.

Wu, Y.V. et al.
Oat protein concentrates from a wet-milling process: composition and properties.

Wu, Y.V. & String fellow, A.C.
Protein concentrates from oat flours by air classification of normal and high-protein varieties.

Comments

A wet-milling process was developed. Different solvents and pH values were evaluated for their effectiveness in extracting an oat protein concentrate.

Protein isolate produced from commercial corn germ, contains 74% protein (N X 5.4), 6% lysine with a good balance of other essential amino acids.

The protein concentrates, starch and residue fractions were analysed for amino acid composition, protein, starch, fat, fibre, ash, and various neutral carbohydrates.

Oat groats, as well as first and second flours, from a high-protein variety (Garland) and from a normal-protein variety (Sioux) were finely ground and air-classified to yield fractions with protein contents (NX 6.25) ranging from 4 to 88%.

4. Rice

Wakefield, L.M. & Rowlands, R.
Protein quality of rice polish and combinations with peanut flour, fish protein concentrate and lysine.
Cereal Chem. 50(1973):4, 428-34.

Assessment of proteins by cumulative wt. gain, protein efficiency ratio (PER), biological value (BV), and digestibility coeff. (DC) indicated rice polishings as an effective means of increasing BV and PER in animal feeding experiments. Rice polishings unused in India may have market potential alone or blended with fish flour as a protein source.
5. Peas and Beans

Hallab, A.H. et al.
The Nutritive Value and Organoleptic Properties of White Arabic Bread Supplemented with Soybean and Chickpea.

Luh, B.S. et al.
Utilization of Dry Lima Beans for High Protein Bread.

Prabhavathi, C. et al.
Effect of baking on the protein quality of high protein biscuits.

Comments

The nutritive value and organoleptic properties were studied on white Arabic bread supplemented with 10, 20, 30, 40 and 50% chickpea flour and 4, 6, 8 and 10% soybean flour.

The effect of baking on the protein quality of experimental high-protein biscuits made from wheat and groundnut flours supplemented with Lysine-rich flour such as soybean, wheat germ and peaflours was studied by measuring PER.
F. SINGLE CELL PROTEIN

1. Reviews

Akin, C. & Flannery, R.J.
Single-cell proteins.

Anon.
Proteins from microalgae and microfungi.
Annales d'Hygiene de Langue Francaise,
Medecine et Nutrition
Source: Food Sci. & Technol.

Anon.
Proteins from hydrocarbons.

Anon.
Symbaprocessen;
Vattenrenning ger protein.
Sv. eko. F. Tids.

Anon.
New information from the M.I.T. conference on single cell protein.

Comments

Review of SCP properties such as nutritional value and functionality; some treating processes such as RNA removal; and some food applications, both current and potential.

Some aspects on the "Symba" method are discussed.

Questions about fermentation processing, animal feeding and economics are discussed for the:

a) Tate & Lyle carob utilization project (Aspergillus niger).
b) ICI bacterial methanol-substrate process (Pseudomonas).
c) PEKILO-protein project (Paecilomyces)
d) Microfungal product from the Lord Rank Research Centre, England.
e) Yeast protein produced by the British Petroleum Company (Candida).
f) The industrial production of yeasts from n-alkanes in the Soviet Union.
g) SCP projects in southern Italy. Solid waste utilization and the biological effects of lignosulfonic acids are also discussed.


Comments

The following subjects are discussed:

a) Suitability of SCP for human consumption.
b) Feasibility of SCP production in developing countries.
c) Correction of protein values of SCP in relation to nucleic acid content.
d) Collaboration with other international groups (IUPAC, EEC).
e) Recent development in Spirulina.
f) National acceptance of SCP.


The SCP-from-cellulose process is defined and evaluated. Discussed are substrates used for fermentation, the treatment of cellulosics; the organisms and the inoculum preparation employed in the testing; batch and continuous fermentations; and product harvesting. Economics of the conversion process are analyzed and flow sheets showing the overall pattern of the process are presented.

A review of the over population problem, the need of proteins, and the possibility of obtaining synthetic proteins from paraffins by fermentation.

The following aspects on single-cell production from methanol are discussed:  
1) methanol (methane) economics  
2) status of SCP from methanol  
3) composition of methanol-grown cells  
4) engineering aspects of methanol-derived SCP.
El-Nawawy, A.S.
Single-cell protein from Egyptian raw materials.

Enebo, L.
Extraction of protein from micro-algae and yeast.
Development grant for the production of protein concentrate from micro-organisms.
STU Anslag No. 720354.

Enebo, L.
Single-cell protein.
Wennner-Gren Center

Gaskell, T.
Protein from petroleum.
Proteins Food Supply Repub.
Source: Chemical Abstr., 78(1973):17, 109242S

Gutcho, S.
Proteins from hydrocarbons.
Park Ridge, New Jersey, USA, Noyes Data Corp. 4(1973), 221 pp.

Comments

The production of food yeast from Egyptian raw materials, such as molasses, bagasse pith, maize cobs and stalks, is discussed and details given of the use of the paraffine fraction of petroleum for the production of fodder yeast. Yeast strains used included Candida lipolytica, C. tropicalis, C. pelliculosa and C. utilis, of which C. pelliculosa proved to be a promising food yeast and C. lipolytica gave good yields on the petroleum fractions.

Factors which must be taken into account when producing single-cell protein (SCP) are outlined. These include the selection of suitable species of microorganisms on the basis of crude and essential amino acid content and digestibility. The latter being dependent upon the properties of the cell wall. Raw materials, culture and harvesting techniques and SCP production costs are discussed.

Topics mentioned include the historical aspects of protein production from petroleum; microbial growth on n-paraffins; the processes of ferment., product recovery, and purification; and toxicological testing and nutritional values.

The book is based on US patents since 1965 relating to the production of proteins from hydrocarbons. It is divided into 5 main sections:
1) Liquid hydrocarbon feedstocks,
2) Gaseous and solid hydrocarbon feedstocks,
3) Growth promoting techniques,
4) Fermentation techniques,
5) Recovery techniques,
Hutchinson, J.M.
Single cell proteins from hydrocarbons.

Jaleel, S.A. & Soeder, C.J.
Current trends in micro-algal culture as protein source in West Germany - food and feed applications.
Indian Food Packer 27(1973):1, p. 45-57

Kato, K.
Development of new food resources.
Source: Chemical Abstr., 79(1973):15, 90542m

Lembke, A. et al.,
Microbial protein production.

Martini, A.
Yeast single-cell protein in human nutrition.

Comments

A review on current trends in micro-algal culture with the following sections
1) Mass cultivation
2) Technological aspects
3) Growth environment for large scale cultivation
4) Nutrient solution
5) Growth characteristics
6) Algal contaminants
7) Harvesting and processing
8) Packaging and storage
9) Microbiological status of the finished algal powder
10) Physico-chemical characteristics of the product
11) Nutritional evaluation of algal protein
12) Consumer acceptability
13) Prototype food mixtures based on micro-algal
14) Role of algal in space travel

A review on the development of single cell protein and the evaluation of its safety.

The use of yeast protein in human nutrition and associated potential medical problems considered.
Nakayama, O.
Proteins of algae
Up-to-Date Food Processing (Shokuhin Kaimatsu)

Ogasawara, N.
Protein production from gaseous hydrocarbons and its technological applications.
Source: Chemical Abstr.

Ogata, K.
Food and feed development for the future. Petroleum protein.
Source: Chemical Abstr.
79(1973).

Pis, E.
Utilization of yeast proteins in the food industry.

Pokrovskii, A.A.
Prospects for utilizing proteins of single-cell organisms. Human nutrition.

Reed, G.
Yeast food.
Baker's Digest, 46(1972):6, p. 16-17, 60.

Yeast for partition into food ingredients.
Abstr. of Papers, Amer. Chem. Soc. 166, MICR 17 (1973)

Comments
Review. Topics include: kinds of algae used as foods; nutritive value of algae (amino acid composition of Euglena, Chlorella and Spirulina in comparison with soybean meal, petroleum yeasts and beef) and cultivation of algae.

A review on single cell protein production from gaseous hydrocarbons and its utilization as food.

A brief review on single cell protein.

A review of yeasts produced using carbohydrate and mineral oil media. High nucleic acid content in the yeast cells used as the food increased the production of uric acid in the animals. For direct fortification of meals, yeast must be deodorized.

A review on yeast food.

A process has been developed which utilizes whole yeast cells as a source of high quality protein having an extremely low RNA content. This is a rheologically novel glycan useful in food processing, and a water-soluble component which is both a flavorant and a flavour amplifier that imparts desirable sensory qualities to food. Yeast biomass is grown from members of the genera Saccharomyces, Candida or Kluyveromyces.
Senez, J.C.
Industrial manufacture of food products from hydrocarbons

Shacklady, C.A.
Yeast grown on hydrocarbons as new sources of protein.

Soeder, C.J. & Subardja, M.
On the suitability of microscopic algae as a food supplement.

Solomons, G.L.
Fungal protein.

Solomons, G.L. & Spicer, A.
Production of edible fungal proteins.

Tannenbaum, S.R.
Single-cell protein production.
p. 40-44.

Waart, J. de
Microbial food production.

Comments
A review on the production of single cell protein from various substrates, including the cultivation of yeast on petroleum fractions. The nutritive value of these yeasts for animal as well as human feeding is discussed in detail.

Trials on production and use of algae as a food supplement are discussed with special reference to the green alga Scenedesmus (crude protein content approx. 55% of dry material) and the blue-green alga Spirulina (crude protein > 65% DM). Production costs per kg crude protein approach those of soybean protein. Crude protein from Scenedesmus had a biological value of 81.5% and was toxicologically harmless, but had a high nucleic acid concentration (approx. 4% DM).

Growth rates, protein content and toxic substances of fungi, screened at the Lord Rank Research Centre, are discussed.

Edible fungal mycelium from a carbohydrate - limited culture of Penicillium notatum-chrysogenum was incorporated into food.

Review. The use of hydrocarbons as substrates for yeast and bacteria production, methods of isolating protein from the cells, and the nutritive value of the protein is discussed.

The role of microorganisms in food production is briefly reviewed, including single cell protein. The high nucleic acid content of the latter makes it unsuitable for direct food use.
Walker, T.
Protein production by unicellular organisms from hydrocarbon substrates.

Ed. Pontanel, G. de Paris VI, France, Comite Scientifique, Symposium d'Aix-en-Provence (Foch Res. Centre Paris, France)

Comments
A review of protein production by the fermentation of hydrocarbons.

Work on proteins from single-cell organisms presented at the 1972 Symposium at Aix-en-Provence and relevant guidelines of the UN Protein Advisory Group are reported.
2. Processing

Abbot, B.J. & Clamen, A.
The relationship of substrate, growth rate, and maintenance coefficient to single cell protein production.

Amaudric du Chaffaut, J. & Magnoux, C.R.
Proteins by gas oil fermentation.
Ger. Patent 2.317.841 (1973)

Anon.
(Asahi Chem. Ind. Co. Ltd.)
Yeast product.

Anon.
(ESSO Research & Engineering Co.)
Protein production.
British Patent 1 326 582 (1973)

Anon.
(Hitachi Ltd.)
Microbial protein purification.
British Patent 1 322 160 (1973)

Anon.
(Hitachi Ltd.)
A method of recovery proteins from microbial cells.
British Patent 1 323000 (1973)

Comments

Various organic compounds were assessed as potential substrates for single cell protein production. Substrate evaluation was based on costs associated with the substrate O2 consumption and heat yield.

Microbial protein was manufactured by nonaseptic continuous or charge fermentation of gas oil by Candida tropicalis.

The digestibility of yeast is improved by treating intact Saccharomyces cerevisiae cells with a higher plant protease such as papain.

A process for the aerobic fermentation production of protein employing methanol as the sole source of carbon is described.

In a process for the extraction of microbial cellular protein, microbial cells are treated with dilute alkali, to extract the proteins, followed by gel filtration to effect desalting and removal of low mol. wt. materials. The protein is then separated by precipitation at the iso-electric point of pH 3-5.

Extracts of protein from microbial cells such as bacteria, yeast, fungi, algae and protozoa are subjected to isoelectric point precipitation in the presence of an alkali metal or ammonium salt to aid aggregation of the precipitate.
Protein is obtained by culturing a microorganism (e.g., Pseudomonas ambigua or P. fluorescens) on a medium containing the product of the pyrolysis of a polymeric by-product of the manufacture of polypropylene, polyethylene, or co-polymers of ethylene and propylene.

A hydrocarbon-assimilating yeast of the genus Candida is subjected to a mutagen, after which the mutants are cultured and those with cell wall deficiencies selected for further culture to yield an easily extractable proteinaceous material.

The PEKILÖ process for the production of protein is based on the continuous cultivation of submerged micro-fungal cultures in a special fermentor using the spent liquor of a sulphite pulp mill. Micro fungal mass from the fermentation process is filtered, washed and dried. Spent solution can be burnt in the pulp mill's evaporation plant. The process can be installed between the cooking department and the evaporation plant. Commercial production of PEKILÖ protein, its composition and advantages of the process are also considered.

A mycoprotein powder, RHM, containing up to 50% high quality protein produced by continuous fermentation on any available starch substrate is being developed by 2 major companies. Laboratory and pilot plant production is currently being translated into continuous production on a factory scale, together with work on processing and flavouring to permit presentation in various forms.
Bauer-Staeb, G.
Yeast protein of foods.
Ger. Patent. 2,318,792 (1973)

Bomar, M.T. & Schmid, S.
Control of the bacterial breakdown of cellulose.

Carta, G.R.
Single-cell protein material as a food supplement.
U.S. Patent 3,778,349 (1973)

Crawford, D.L., McCoy, E.,
Harkin, J.M. & Jones, P.
Production of microbial protein from waste cellulose
by Thermomonospora fusca,
a thermophilic actinomycete.

Cuevas, C.M. & Ertola, R.J.
Utilization of malt sprouts for production of singel cell
proteins. I. Effect of malt sprout extract on growth rate
and cell yield on whey medium.

Damberg, B.E., Upit, A.A.,
Vitolin, S.P. & Valdrietse, A.T.
Method of obtaining protein products from a yeast biomass.
USSR Patent 379616 (1973)

Comments
Protein preparations of good organoleptic properties, useful for foods,
were prepared from Saccharomyces cerevisiae.

Cellulose was used as a C-source for bacterial growth in single-cell protein
production. A good correlation was shown between the breakdown of
 cellulose and CO₂ production. The inhibition of cellulose breakdown
after 24 h of fermentation was shown to be due to the remaining cellulose
being in a form non-hydrolysable by the bacteria.

Paper-mill white water supplemented
with mineral salts and yeast extract
is used as a medium for growth of
Cellulomonas cartalyticum

A cellulolytic, thermophilic actinomycete, Thermomonospora fusca, was
used in a study to test its potential
for converting pulping fines, a
cellulosic waste of the paper industry, to microbial protein. Pre-
liminary feeding studies with baby chicks and amino acid analyses re-
vealed that the protein is of good
nutritional value and contains no
strongly toxic materials.

The effect of adding 0.25-1.5 g/1
malt sprout extract (MSE) to a
whey cultural medium on growth rate and yield of Saccharomyces
fragilis was compared with addition
of yeast extract (YE).

In obtaining protein products by
drying a yeast biomass in a fluidized bed, product consistency and biologi-
cal value are improved and losses on
drying are reduced, by adding sprouted
malting grain to the biomass before
drying, preferably in amount of 8-10%
calculated on a dry weight basis. The
mixture is preferably dried at 140-
170°C to a residual moisture content
of 2-4%.
Dietrich, H., Polan, M., Schneider, K., Rasen, G., Warhmann, R., Piles, R., & Hoppe, S.  
Method of obtaining protein.  
USSR Patent 395 433 (1973)  
Source: Food Sci. & Technol.  

El-Syed, M.A., El-Refai, A.H., & Mohamed, T.A.  
Production of proteins by Azotobacter chroococcum  
Pakistan J. Sci. & Industr.  
Source: Food Sci. & Technol.  

Fencl, Z., Machek, F. & Schillinger, V.  
Yeast proteins of low nucleic acid content for human and animal nutrition.  
Source: Chemical Abstr.  

Fors, K.  
Pekilo-processen - en Fou-product från Central laboratorium ÅC.  

Plastein  
Source: Chemical Abstr.  

Fujimaki, M., Utaka, K., Yamashite, M. & Arai, S.  
Production of higher quality plastein from a crude single-cell protein.  
Source: Food Sci. & Technol.  

Comments

A discussion of the process whereby microorganisms, e.g. yeasts, are grown in a nutrient medium containing petroleum hydrocarbon fractions and mineral salts to obtain protein.

Details are given of the cultivation of Azotobacter chroococcum in a laboratory scale fermentor to explore the possibility of commercial production of protein.

Proteins were isolated from Candida utilis, C. lipolytica, Saccharomyces cerevisiae, or Escherichia coli by disintegration of the cells at alkaline pH and 4-10°C, removal of the cell walls, precipitation of the protein and by acidification and extraction of lipids by iso-ProH and drying. Optionally the protein suspension obtained after cell wall removal was heated 1 hr at 53-60°C and pH 5.9-8.0 to activate the nuclease which degraded the nucleic acids.

The production of single-cell protein by the PEKIL0-process is discussed. Discussion on feeding experiments are included.

A 10-60% aq. solution of an oligopeptide produced by hydrolyzing soybean or petro-yeast protein 60-70% and having an average molecular weight of 1200-2000 was treated with a -chymotrypsin, pepsin, neutral proteinase and subtilisin from Bacillus subtilis or Aspergillus peptidase A to yield plasteins free from offensive taste and odor and useful as foodstuffs.

A protein-like foodstuff (plastein) was produced from a crude petro-protein via its peptic hydrolysate by repeated enzyme and solvent treatments. From a purified protein hydrolysate a plastein was synthesized with Bioprase and precipitated from the reaction mixture with aqueous ethanol or acetone.
Hachiya, Y., Fukuoka, S., & Iwamoto, H.  
Production of bacterial cells from methane. I. Isolation and cultivation of methane utilizing bacteria.  
(Kogyo Gijutsu-In Hakko Kenkyusho Kenkyu Hokoku)  

Hedenskog, G., Mogren, H. & Enebo, L.  
Förfarande för framställning ur mikroorganiser av protein-koncentrat med låg halt av nukleinsyra.  
Swedish Patent 355823(1973)

Hedenskog, G. & von Hofsten, A.  
The ultrastructure of Spirulina platensis - A new source of microbial protein.  

Hedenskog, G., Mogren, H. & Enebo, L.  
A method for obtaining protein concentrates from microorganisms.  

Hedenskog, G. & Mogren, H.  
Some methods for processing of single-cell protein.  

Comments

With the intention of producing a single cell protein using methane as the sole C-source, methane-utilizing bacteria were isolated and examined. Methane-utilizing bacteria isolated from natural gas fields in the area Chiba were Gram negative rods of various colours.

The production of a single-cell protein concentrate with a low amount of nucleic acid is outlined.

Cells of Spirulina platensis were disintegrated and extracted with different concentrations of NaOH and the amount of extractable and isoelectrically precipitable nitrogen was determined. High yields were obtained with about 60% of the nitrogen precipitated after extraction of disintegrated cells.

The degree of disintegration of microorganisms such as micro algae, yeasts, bacteria in a special ball-mill was compared. Non disintegrated and disintegrated cells were extracted with NaOH and the amount of extractable nitrogen and the amount of nitrogen precipitable at pH 4.0 were determined. The dependence of yield on the NaOH concentration, extraction time, and temperature was studied. An optimum was found with 0.3 - 0.5% NaOH at pH 11.0-11.5 the precipitate obtained represented 60-70% of the cell nitrogen.

Protein concentrates with and without cell walls were produced from mechanically disintegrated yeast. The different fractions which were obtained when separating cell walls and precipitating protein by heating at alkaline pH were analyzed. The protein precipitate obtained after cell wall separation had an RNA content of less than 2% and contained 70-75% of the amino acids in the yeast starting material.


Comments

To enable utilization of protein in the surplus activated sludge, the conditions to liberate the amino acids from the sludge protein were investigated employing pronase (proteinase from S. griseus) digestion for 72 hr at 50°C after mild hydrolysis with dilute hydrochloric acid or sulfuric acid.

Baker’s yeast (Saccharomyces) and yeast of the Candida family were grown on n-paraffin. Proteins were extracted using 0.10 to 0.25 M NaOH for 30 to 60 min. The temperature was 80 to 90°C. Over 80% crude protein and crude ash less than 0.1% were recorded with the pH 4.5 isoelectric precipitates from the supernatant liquid treated at 80°C for 60 min with 20 changes of 0.125 M NaOH solution.

Different fungal organisms are cultivated in a water extract of the pods of Carob (Ceratonia siliqua). The selected organism from 300 screened was a wild strain of Aspergillus niger. The dried mycelium proved to be non-toxic, palatable and to have a good potential for use as an animal feed.

By controlling the rate of medium flow and distillate concentration it was possible to achieve either maximal productivity of yeast biomass or max. level of petroleum distillate deparaffinization.

A concentrate is obtained by cultivating associative cultures of Rhodoturula glutinis and Candida tropicalis in hydrocarbon media. The population of each being controlled, preferably by varying the amount of ammonium-N in the medium.


Comments

Studies on production of single-cell protein by Hydrogenomonas eutropha H16 are described. The limiting factor for growth was supply of gas. For optimal supply of H₂, O₂ and CO₂, best results were obtained with a flow meter or gas pump. A complete plant for autotrophic continuous mass culture of H. eutropha is shown diagrammatically. The biological value and amino acid composition of the protein are comparable to casein, but with more lysine and less aromatic amino acids. DM contains 50% protein and 15% nucleic acid. Under optimal conditions, production of biomass from CO₂ and H₂ can reach 22 g DM/12 g C.

Effects of different petroleum fractions, stepwise addition of calculated amounts of a special petroleum fraction at defined intervals and re-cycling of spent media on cell growth on Candida tropicalis KIST 351 were studied using a batch process. Continuous cultivation of the yeast was also studied.

Colorless protein was obtained by disintegration of yeasts in a continuous horizontal disintegrator of 5 l volume. After disintegration, the cell walls were separated and the nucleic acid content decreased by the reaction of nuclease which were activated by disintegration and heating.

Pseudomonas methylotropha, P. rosea, Microcyclus polymorphum, and (or) Hyphomicrobium variabile are cultivated in media containing MeOH as C-source, a N-source and nutrient salts to give a biomass of high protein content. Thus P. methylotropha was grown in 2 l, to give in 48 hr 10.4 g dry biomass containing 65% protein.
Maclean, D.G.
Methanol-bacterium process for the production of single-cell protein.
Source: Chemical Abstr. 78(1973):25, 157845N.

Mitsuda, H., Tonomura, B., Kawai, F. & Maekawa, T.
Protein isolates from hydrocarbon assimilating microorganisms.

Mitsuda, H.,
Protein isolates from Chlorella, Algae, Torula yeasts and hydrocarbon-assimilating microorganisms.
Chemical Abstr. 79(1973):19, 114176Y.

Mogren, H.
Mechanical disintegration in processing of single-cell protein.

Mogren, H., Hedenskog, G. & von Hofsten, A.
The influence of heat processing and mechanical disintegration on yeast for single-cell protein.
Physiol. Plant. 29(1973) p. 82-91.

Paredes-López, O., Medoza-Madrid, J.E. & Camargo, E.
Production of single-cell protein from waste paper by a mixture culture.

Comments

The preparation of protein isolates from hydrocarbon-assimilating bacteria (Alcaligenes sp.) and yeast (Candida spp.) are described. Chemical and physico-chemical properties of the isolates, nutritional evaluation of the isolates and disposal of the extraction residues are also discussed.

Practical methods for the preparation of protein isolates from Chlorella, Algae and Torula yeast are described. The protein isolates from each of the 3 organisms were limited in S-containing amino acids but abundant in lysine. The digestibility of the isolates by pepsin or trypsin approached that of milk casein. Only the protein isolate from yeast could be extruded as a fibril and only when small amounts of either Na-alginate or soy protein had been added.

A discussion on the production of concentrates from single-cell cultures especially the disintegration problems.

Yeast was processed by means of various technical drying procedures, heating in water suspension and mechanical disintegration. The influence on the ultrastructure, the nutritive value and on the availability of the cell nitrogen-containing compounds to chemical extractants were studied.

Biomass production, cellulose (newspaper) utilization and variation of pH using the mixed culture "Y-11", are described.
Pis, E.

Growth of Proactinomyces, Mycobacterium and Micrococcus on hydrocarbons.
Prikladnaya Biokhimiya i Mikrobiologiya 9(1973):4, p. 539-545.

Romantschuk, H.
Pekilo-processen - finskt pro- jekt för välfärdsmarknad.

Sassa, N.
Treatment of microbial cells.
French Patent 2.159.722 (1973)

Schnabl, H. & Rehm, H.J.
Protein production and metabolic products of some Pseudomonadaceae grown on alkanes, particularly tetra-decane.

Comments

Pressed waste and fodder yeast, yeast suspensions, partly decomposed yeast and yeast directly from the producer can be used for autolysate production. The raw material is mixed with water, heated to 47-50°C with constant stirring and poured into the autolyser. After 48 h of activation and autolysis, the material is heated to 70-75°C and the extract separated from the cell remnants in a centrifuge. After filtration, the autolysate is thickened to a water content of 25-30% and filled into containers. It can be used as a food additive.

Strains of Micrococcus, Mycobacterium and Proactinomyces were studied. Most of the strains giving a high biomass yield (80-110%) on media containing purified paraffins (C14-C22) consumed rather poorly n-alkanes from oil distillates which included, in addition to straight chain paraffins, aromatic isoparaffin, naphthene hydrocarbons and other compounds.

The PEKILQ process is discussed.

Dry food products without off-odors are prepared from cell cultures such as yeasts, bacteria or fungi, grown on nutrients such as hydrocarbons CH4, MeOH, or AcOH.

Pseudomonas aeruginosa, Ps. fluorescens and Acetobacter peroxydans were adapted to a viscous paraffin mixture as sole carbon source, and the amino acid composition of the cellular proteins subsequently studied. The bacterial protein concentrates contained a lower content of methionine than fish meals (1.1-1.2 vs. 1.7%) but a higher content than brewer's yeast (0.9%) and dried skim-milk (0.8%). Addition of homocysteine to the medium increased the cystine content of the cells.
Shimizu, N., Ishida, M. & Muroi, T.
Separation of microbial protein.
Japan Kokai 7308791 (1973)

Shimizu, N., Ishida, M., Oguri, Y. & Muroi, T.
Separation of microbial protein.
Japan Kokai 7308792 (1973)

Spicer, A.
Proteins from carbohydrates.
Microfungi Food.

Tong, P.Q., Riel, R.R. & Simard, R.E.
Optimum conditions for protein synthesis on potato substrate by Rhodotorula rubra.

Walker, T.
Protein from petroleum.

Watanabe, K., Shimada, Y., Kawaharada, H., Suzuki, K. & Tanaka, F.
Fermentative production of high-protein yeast cells.
Ger. Patent. 2 038 693 (1971)

Comments

Protein was extracted from microbial cells with an alkali. The protein solution was then treated with a cation exchange resin to remove the alkali and adjust the pH to 6.0-10.5. Finally, the protein was precipitated from the pH-adjusted solution by isoelectric precipitation, \( \text{Me}_2\text{CO} \), EtOH or \( \text{CCL}_3\text{COOH} \).

Protein was extracted from microbial cells by an acid. The protein solution was treated with an anion exchange resin to remove the acid and adjust the pH to 2-3.5. The protein was precipitated from the pH-adjusted solution by isoelectric precipitation \( \text{Me}_2\text{CO} \), EtOH, or \( \text{CCL}_3\text{COOH} \).

A process to produce a fungal protein from cereals and sugar is described. The amino acid profile of the protein is compared with the FAO ideal profile and the profile of some other microbiological proteins. Organoleptic and processing questions are also discussed.

Two processes developed by British Petroleum for the production of proteins from liquid normal paraffins are described. The first process uses a substrate of high purity \( \text{n} \)-paraffin in the range \( \text{C}_{11} \) to \( \text{C}_{18} \) which is almost completely consumed during fermentation. The second process uses standard refinery heavy gas oil as substrate from which the \( \text{n} \)-paraffins are preferentially consumed. In this case only 10% of the substrate is consumed.

Candida novellus is grown aerobically in a liquid medium containing biotin, a N-source, nutrient salts, and normal \( \text{C}_{9-30} \) paraffins as C-source.
3. Nutritional value and functional properties

Akin, C. (Standard Oil Co)
Texturizing microbial cells by alkali-acid treatment.
Source: Chemical Abstr.
80(1973):17, 94385f.

Anon.
(Standard Oil Co)
Texturizing process for single cell protein products.
British Patent 1,322,125 (1973)
Source: Chemical Abstr.,

Balmaceda, E. & Rha, C.K.
Rate of coagulation of single cell protein concentrate.

Bello, J., Larralde, J. & Villanueva, R.
Source: Chemical Abstr.

Bello, J., Larralde, J. & Villanueva, R.
Protein digestibility of food yeasts.
Saccharomyces cerevisiae, Candida utilis and Candida lipolytica
Source: Chemical Abstr.

Comments

Single cell protein material from bacteria, yeasts, and fungi is given desirable food textures by mixing an aq. slurry (5-30% by wt. of cell) of the material with ~ 0.5-20% by wt. of an acid or an alkali until the viscosity is increased 2-9 times and extruding or spraying the mixture into a bath of the opposite acidity. The dry fibers were brittle and became soft but did not disperse into single cells in H2O.

The texturizing protein product is made by simultaneously extruding, shearing and heating an aq. paste of yeast or bacterial cells, cooling and then drying.

In view of the fact that the convenience of single cell protein (SCP) to "acceptable" forms of synthetic food frequently involves coagulation of the protein, a basic study of the coagulation characteristics of SCP was made.

Amino acid analysis of C. lipolytica grown on pure-paraffins showed a deficiency in S-containing amino acids. Growth and protein retention of male rats, fed 8 or 12% yeast proteins or casein or whole egg, showed lower biological values and protein conversion ratios for the yeast proteins.

The digestibility of the proteins from dried baker's yeast (S. cerevisiae), torula yeast (C. utilis) and hydrocarbon grown yeast (C. lipolytica) was assayed in vitro and in vivo. A high inhibition of in vitro tryptic hydrolysis was observed in all cases, evidently due to the presence of inhibitors in yeast proteins. In vivo experiments in rats receiving casein and yeast proteins at 8% and 12% levels showed a lower digestibility of yeast proteins and an inverse relation between digestibility and protein concentration.
Elmadfa, I. & Menden, E.
Enrichment of yeast protein with methionine.

Hayakawa, I. Khai, N. & Nomura, D.
Bleaching of yeast protein and its dynamic viscoelasticity.

Huang, R. & Rha, C.-K.
Fiber formation from single-cell protein.

Ishida, M., Oguri, Y., Shimizu, N. & Muroi, T.
Protein precipitation from microbial protein solution.
Japan Kokai 73 80,790(1973)

Labuza, T.P. & Jones, K.A.
Functionality of yeast protein dried at two temperatures.

Lindblom, M.
Alkali treatment of a yeast protein concentrate.

Comments

The protein efficiency ratio of dried yeast (Candida utilis) was increased to the same value as casein, as a result of supplementation with 0.2% methionine, the first limiting amino acid.

Bleached preparations of yeast protein were obtained from commercial baker's yeast and Candida grown on hydrocarbon by using an Impact-Cell-Mill and bleaching agents. The dynamic viscoelasticities of the bleached protein were determined to elucidate the effect of bleaching on the viscoelasticity.

Alkali-extracted single-cell protein concentrate from Torula dried yeast was put into dopes of various concentration and pH. Different spinning parameters are described.

Protein extracted from microbial cells was precipitated in high yield by isoelectric precipitation in the presence of an alkali metal salt of an organic acid.

Yeast was spray dried at two temperatures (75°C and 124°C) and incorporated into a dough and bread system to measure functionality. The system dried at the higher temperature exhibited much better functional properties but was still not as good as with solids.

An alkali process for treatment of a heat precipitated yeast protein concentrate with a low content of nucleic acid has been studied. The protein concentrate is intended for human consumption. The process involves treatment with alkali at an elevated temperature in order to solubilize the protein. After separation of the insoluble fraction the solubilized protein is precipitated by addition of acid. The solubility was increased and the foaming and emulsifying properties were considerably improved by the alkali treatment. The swelling and the nutritive values were not influenced.
Lindblom, M. & Mogren, H.  
Enzymatic RNA-reduction in disintegrated cells of Saccharomyces cerevisiae  

Lindblom, M.  
The influence of alkali and heat treatment on yeast protein.  

Lipiec, M. & Ilnicka-Olejniczak, O.  
Effect of processing on the content of methionine and tryptophan in food yeast preparations.  

McCormic, R.D.  
Baker's yeast, world's oldest food, is newest source of protein and other ingredients.  

Mueller-Wecker, H. & Kofranyi, E.  
Determination of the biological value of dietary proteins. XVIII Unicellular organisms as a dietary supplement.  

Comments

Degradation of RNA by endogenous RNase in cell suspensions of Saccharomyces cerevisiae was found to be achieved by mechanical disintegration followed by incubation in the presence of NaCl. The incubation parameters pH, temperature, time and concentration of NaCl were investigated. Protein concentrates with a low content of RNA were obtained by precipitation of the incubated suspensions and separation of the degradation products.

The soluble components in disintegrated cells of Saccharomyces cerevisiae were characterized by means of extraction, centrifugation, dialysis and gel filtration. The influence of alkali and heat treatment on the protein and RNA in the soluble fraction from disintegrated yeast cells and on functional properties of protein concentrates were studied.

The lowest losses of methionine (4.3%) and tryptophan (7.3%) take place when yeast cream inactivation is carried out by heating at a steam pressure of 1 atm. followed by spray drying.

The composition (with the amino acid profile of the protein) and vitamin content of baker's yeast (Saccharomyces cerevisiae) are discussed.

Dietary experiments were carried out with dried algae (Scenedesmus obliquus) and dried yeast (Saccharomyces cerevisiae) on 6 healthy young men. Each of the 12 experiments lasted ~3 weeks. The green alga showed both a high biol. value and a high supplementary value. The daily uric acid production was normal. S.obliquus can therefore be recommended as a valuable protein supplement at the
Naess, B. & Salgsvoed, P.
The nutritive value for grown pigs of single-cell protein (Saccharomyces cerevisiae) produced from sulphite spent liquor.

Pillai, K.R., Singh, H.D., Baruah, J.N. & Iyengar, M.S.
Single-cell protein from petroleum.
III Nutritional aspects of single cell protein.

Pronsuk, A., Roszkowski, W. & Bartnik, J.
Nutritional evaluation of selected food yeasts.
I. Essential chemical composition and protein quality of food yeasts.

Raseta, J., Kepcija, Dj., Petkovic-Bacic, L. & Isakovic, D.
Effect of soy and yeast proteins on emulsifying capacity of meat proteins and emulsion stability.

Comments
rate of 20-30g daily. The dried yeast showed a low biological value and no supplementary value. Owing to the high content of nucleic acids, consumption must be limited to about 10g daily to avoid excessive production of uric acid.

The effects on growing pigs of substituting 4.5 and 9% of soybean meal with a corresponding amount of single cell protein produced from sulphite spent liquor in a diet based on cereals and fish meal have been studied. No differences in wt. gain, feed conversion ratio or fat thickness of the pigs, as compared with the controls, were observed when fed single cell protein-containing diets from about 29 to 80 kg in the course of 11 weeks.

Chemical composition, vitamin content, amino acid content and nutritive value of single cell protein (SCP) produced by various yeasts and bacteria grown on petroleum hydrocarbons are given. Most SCP's contained large quantities of lysine but were deficient in methionine. SCP processing conditions were found to affect nutritive value. Some allergic effects and gastrointestinal disturbances were noted, but no toxic effects were reported.

The nutritional value of 4 food yeasts (3 of Candida utilis and 1 Saccharomyces cerevisiae) was studied with respect to fodder yeast (of Candida utilis). The studies comprised the determining of dry wt. protein, fat and ash, and biological determinations of protein digestibility, net protein utilization (NPU) and biological value.

Soy and yeast protein preparations have a favorable effect on the emulsifying capacity of extractive meat proteins. Soy and yeast protein preparations in contrast to muscle (longissimus dorsi) have considerably higher contents of total and extractable N and lower contents of water and fat.
The strength and texture of purified microbial protein (from Torulopsis famata) is improved by the addition of polymeric materials such as Na-alginate, casein, or Na-polyglutamate.

Rats were fed ad libitum a diet containing 5, 21 or 86% of dry C. utilis, supplying protein levels of 2.5, 10 and 40%. Rats fed > 10% yeast showed some pathol. indications and changes in weight of the internal organs.

Six yeast samples grown completely on hydrocarbon oil, 2 bacterial protein preparations and a distillery yeast were compared in chick growth experiments. Various combinations of amino acids were incorporated and mixtures of single-cell protein sources with conventional protein foods were evaluated.

The chemical composition and biological quality (PER and available lysine) were investigated in two batches of Candida utilis (Torula yeast). Amino acid analysis showed a high content of lysine and threonine, but a deficiency in sulphur amino acids. The PER value was 1.80±0.05 and the available lysine value was 6.6 g/100g of crude protein. Supplementation of C. utilis with 0.3% DL-methionine increased the PER value to 2.77±0.03.
Comments

The enrichment of bread with the yeast *Candida utilis* at 1, 2, 3, 6 and 10% cultivated on sugar beet molasses, was studied. The physical characteristics, chemical composition and biological quality of the protein were determined.

4. Applications

Desjounqueres, A.
Protein autolysate and its use in cheese making.
French Patent 2 165 122 (1973)
Source: Chemical Abstr.

Comments
Yeast autolyzates were combined with CaCl₂ to contain: dry matter 20-50%, total N 1-5%, amino N 0.4-2% and Ca 0.5-4%. The autolyzate is precipitated by stirring the yeast and CaCl₂ at low temperature for approx. 1 hr² (plasmolysis) and then adding water to obtain a dry matter content of ~18% and then letting the enzymic process continue at 30-70°C for 12-60 hr. The final processes are filtration and concentration. The preparation stimulates lactic fermentation in cheese making.

Petrovic, N., Djukic, D. & Filipovic, R.
Use of brewer's yeast protein in liver paste manufacture.
Source: Chemical Abstr.

Comments
Debittered brewer's yeast, spray-dried, as an addition in the manufacture of canned liver paste was examined. The influence of spray-dried brewer's yeast on water binding and fat emulsifying properties of liver paste, and then its influence on color, consistency, taste, and odor of finished product were examined.

Swiderski, F., Zmyslowska, Z. & Zalewski, S.
A food yeast preparation for sauce manufacture.