A NEW PERSPECTIVE PROTEIN SOURCE FOR SAUSAGE PRODUCTION

G. Uzunov, L. Tsolova

Mankind is facing the increasingly grave problem, to overcome existing protein shortage which, according to F.A.O. and W.H.O. data, covers the greater part of the world population, i.e., economically underdeveloped countries.

Obviously the problem related to sources compensating protein shortage by new foods of an optimum balance of available and essential amino acids is extremely important and awaits its solution.

On the other hand, individuals working under a high psychic strain constitute a constantly increasing part of the planet's population. That raises a number of further problems in the science of nutrition: greater and greater consumption of wholesome proteinaceous foods of a negligible fat content and with the presence of all the necesssary vitamins, especially those of group B, as well as of salts and microelements.

The potential ways to increase the volume and improve the value of foodstuffs include: the increase of the total output of agricultural production, widened utilization of edible resources of seas and oceans, production of synthetic foods. "The task to obtain foodstufs in a chemical way out of organic and inorganic substances has already been set before mankind. The evolution of science so far gives us grounds to suppose the task will be solved in the near future, what will open unlimited perspectives for the nutrition of milliards of inhabitants on our planet." - Tashev et al., 1966.

In this connection, attention is directed towards the systematic alteration of organism world for the utilization of wild and lower forms as new sources of nutritive substances. Achievements will allow to master the synthesis of all food components and to obtain foodstuffs without the photosynthesis of plants.

For 30 years now soya proteins have been included as a perspective raw material for the production of various foods of the type of meat amd milk substitutes. Recent trends include for such purposes the proteins derived from yeasts, algae, microor-

ganisms grown on petroleum media, etc. However, the application of those sources is still limited since large ground and water areas are required for the production of appropriate proteins, as well as great quantities of raw materials (petroleum) or a lot of labour and expensive equipment.

The higher fungi mycelium obtained in an industrial way by Dr. Torev, appears to be the latest as well as most perspective raw material recently. In many respects this raw material competes the remaining sources (soya, microorganisms, yeasts, etc.) by offering opportunities for rapid production of a large quantity of mass (without photosynthesis) with completely sterile conditions, cheap media and equipment.

Materials and method

For the present experiment we turned towards the application of mycelium of strain $P_5/64$, produced on a liquid medium in fermenters under sterile conditions. Our analyses of the biochemical composition of the mycelium indicated, that that strain corresponds best to the objectives of the present work. The high percentage of crude protein in the composition of $P_5/64$ (Table 1), as well as its easy digestibility, contribute to obtain easily digestible products.

Table 1. Basic indices of strain $P_5/64$ mycelium.

Crude protein	56,6 % of dry substance
Carbohydrates (without cellulose)	21 % of dry substance
Fats	3,6 % of dry substance
Crude fibres	6,4 % of dry substance
Mineral substances	7 % of dry substance
Protein digestibility	83 %
Calorific value of 100 g of product,	340,16 Cal.

In the amino acid composition 16 natural amino acids are included which, compared to those in meat, are in a reduced quantity but in appropriate proportions. It is also important that the essential amino acids shown in Table 2. are included in mycelium composition.

Table 2.

Essential amino acids (% of protein)		Other amino acids (% of protein)	
Arginine	2,79	Alanine	4,43
Valine	2,47	Asparaginic acid	4,37
Histidine	1,15	Glycine	2,19
Isoleucine	1,83	Glutamic acid	6,51
Leucine	3,26	Proline	2,19
Lysine	3,15	Serine	1,99
Methionine	0,79	Tyrosine	1,36
Threonine	2,09		
Phenyl-alanine	1,75		

On the other hand, the biochemical composition of mycelium is of interest for the content of active biological substances which answer a number of requirements of human organism.

Such substances are:

Table 3.

Thiamin	19,9	micrograms/g
Riboflavin	73,9	micrograms/g
Niacin	240	micrograms/g
Choline	6,000	micrograms/g

Another advantage of this protein source is its fibrous structure which gives the possibility to obtain an appropriate structure and texture of both the stuffing made of meat and mycelium and the ready meat products (sausages and canned meats) made of that stuffing.

Mycelium has a white colour with a cream shade and a faint mushroom aroma, so it can be applied in sausages and canned meats without significantly altering them: a faint lightening of product colour is produced which is easily corrected by harmless food dyes. Mycelium can be kept at the same temperatures as meat or stuffing, while at thawing the effects of meat thawing are not present here, and those are considerable advantages of mycelium.

In the production of sausages and canned meats with the ad-

dition of strain $P_5/64$ mycelium, the meat used answers standard requirements, and mycelium is used in its natural state, with a 25 % water content. Before its grinding and mixing with meat, mycelium is thawed (if it has been frozen), treated with 1% acetic or 3% citric acid to eliminate the additional odour produced upon sausage smoking and cooking without this procedure. The mycelium treated in this way is now strained to remove washings, and washed in excess of water. By a subsequent straining mycelium is reduced again to a 20-25% water content. Meat and ready mycelium are ground together in a cutter till a homogenous mass is obtained, the specific technologies being observed for the various types of sausages. During cutting, the spices required by the formulae are added. The remaining processes (filling, smoking and cooking, sterilization, etc.) are performed in accordance with standard requirements.

Analyses

Organoleptic, bacteriological, toxicological, mycological, and chemical analyses were carried out on the ready products.

Chemical analyses indicated the absence of rancidity, hydrogen sulphide and ammonia. pH was in the range of 6,30-6,60; there were minimum amounts of volatile alkaline nitrogen; reactions for protein coagulation were negative. Water content, dry substance, fat content in dry substance depended on the type of product in which mycelium was introduced.

Bacteriological analyses indicated that an average of 300 to 600 organisms of B. mesentericus fall to 1 g of product. No pathogenic microorganisms were isolated in any experimental type of product.

Toxicological analyses found that copper, zinc, arsenic, lead and nitrites, studied by polarography and colorimetry, were discovered in minimum quantities, far below the lower levels of sanitary requirements.

Mycological analyses showed that yeasts, moulds, etc., were not present.

Organoleptic evaluation: taste, colour, aroma, texture, appearance did not deviate from those in standard products.

Discussion

Our observations indicated convincingly that strain $P_5/64$ mycelium constitutes a bioproduct of a high biological value

which comes into appropriate structural relationships with the various meats used in sausage and canned meat production and also it substitutes effectively meat raw materials and releases high quality meat. It is clear that, depending on the scales of sausage production in a given country, the application of this mycelium would have a great economic effect: free meat increases without the increase of the number of animals, the level of sausage production being also retained. Furthermore, mycelium has a very low cost, which contributes to lowering the price of the products whose component it is.

Besides, the chemical composition of mycelium, which depends on medium composition and production mode, can be controlled in such a way that a higher concentration of some of the basic components is achieved. In this sense, fat content can be minimized, so that in sausage and canned meat production one may use fat and semi-fat meats which are difficult to realize otherwise. The fibrous structure of mycelium which is its natural state, does not require additional expensive equipment in order to preserve ready meat product structure and texture unchanged. It is of interest also, that an excellent binding between meat and mycelium is obtained already during cutting.

According to our observations, sausages with mycelium have a longer storage life than conventional ones.

All of these advantages, and particularly the circumstance that the protein contained in mycelium approaches animal protein in both essential amino acid content and comparatively high calorific value, make this bioproduct suitable for a substitute of part of the pork and beef.

L I T E R A T U R E

1. Mashek, I., Voprosi pitania, 1, 1972, Praha

2. VOZ-seria technitsheskih dokladov No 258 - Komitet ekspertov po medizinskoi ozenke sostoiania pitania, Geneva, 1964.

3. VOZ-seria technitsheskih dokladov No 340 - Sovmestno soveshtanie FAO/VOZ po metodom planirovania i ozenki program prikladnogo pitania, Geneva, 1967.

4. Tashev, T., M. Demireva, N. Milev, Savremeni problemi na hraneneto, BAN, 1-6, 1966.

5. Torev, A., Promishlena technologia sa polutshavane na mizel ot niakoi vidove visshi gabi i negovoto praktitshesko ispolzuvane. Doktorska disertazia, Plovdiv, 1970.

6. Shivrina, A.N., Niskovaia, O.P., Falina, N.N., Matisson, N.L., Effimenko, O.M., Biosintetisheskaja dejatelnost visshih gribov. ANSSSR, Botanitsheskii institut im. W.L. Komarova, Leningrad, 1969.

7. FAO - Etudions la nutrition, Rocke, 1968