DEFINITION, BENEFITS, PROCESSING AND EXAMINATION OF FUNCTIONAL FOODS

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(Pannon University, Agricultural Science Mosonmagyaróvár, 23th March 1999)

ABSTRACT

In generally, a functional food can be defined as any food that has a positive impact on an individual, health, physical performance or state of mind as well as its normal nutritional values. The Japanese Ministry of Health and Welfare has identified 12 very broad-based classes of ingredients, which they consider to be health enhancing. The are dietary fibre, oligosaccharides, sugar alcohol's, aminoacids, peptides and proteins, glycosides, alcohol, isoprenoids and vitamins, cholins, lactic acid bacteria, minerals, polyunsaturated fatty acids and others (e.g. phytochemicals and antioxidants). As consider, amaranth, quinoa and pea seed all some of the attributes of functional foods. These seeds fulfil the requirements for functional foods in many ways. The prolamin type protein content of this seeds low, therefore these seeds are suitable in the diet of people suffering from celiac disease, and emulsifiers are required to form the dough structure. In the presence of emulsifier an emulsifier-carbohydrate-protein-lipid complex can be expected. The rate of the individual interactions depends on the components of the given sample. It was examined the developed pasta products from point of interactions and the quality of products.

Functional foods, designer foods, pharmafoods and nutraceuticals are synonyms for foods that can prevent and treat diseases. In generally, a functional food can be defined as any food that has a positive impact on an individual' health, physical performance or state of mind as well as its normal nutritional values. The Japanese have highlighted three conditions that which define a functional food:

- It is a food (that is not a capsule, tablet or powder) which derived from naturally occurring ingredients.
- It can and should be consumed as part of the daily diet.
- It has a particular function when ingested, serving to regulate a particular body process, such as: enhancement of the biological defence mechanisms; prevention of a specific disease; recovery from a specific disease; control of physical and /or mental conditions; slowing the ageing process.

The idea of health-filled foods is of course, not new. The modern message probably took root in the soil of the classical nutrition studies in the 1950's and "back to the nature" revolution in the 1960's. The message was to produce processed and packaged food, which retained its nutritional quality, and appeared and tasted as close to natural as possible. In the sixties, medicine and food producers entered their first unlikely partnership.

Today, the concepts of nutrition, natural foods, minimal addition of additives or merge into a modern field of new and challenging scientific investigation. Not only do food ingredients in proper combinations actually offer potential or actual benefits in preventing or treating special conditions or diseases, but these food ingredients can occur naturally or can be produced by biological technologies such as genetic engineering.

Diet is believed to play an important role in the for major disease of our society, for example: cardiovascular (hearth and artery) disease, cancer, hypertension and obesity. Hearth disease and cancer together account for 70% of all deaths, although the exact degree to which diet is important in the prevention of these diseases is not known. A commonly accepted estimate among experts is that at least 1/3 of the cancer cases can be attributed to diet and perhaps 1/2 of the cases of hearth and artery diseases and hypertension also related to diet. The major food components associated with cardiovascular diseases and cancer are: fats, particularly too much saturates fat and the under consumption of dietary fibre from vegetables and fruits.

In the 1980's, the potential medical benefits of different food ingredients such as calcium, fibre and fish oil was all substantiated. Today various ingredients are being studied for their role in preventing or treating various chronic diseases and also for their far-reaching benefits in slowing the ageing process and affecting mood and performance. Recent examples include the use of fish oil supplements and antioxidants to reduce the damage caused by arteriosclerosis.

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These ingredients appear in a full menu of food products ranging from breakfast cereals to salad dressing.

EXAMPLES OF FUNCTIONAL FOODS

Milk products. Since 1908, when Eléie Metchnikoff (Nobel Prize laureate) suggested that consumption of milk fermented with lactobacilli would prolong one's life, there has been an interest in the potential health benefits associated with these organisms. Potential health benefits include: improved lactose digestion, reduction of serum cholesterol, tumour inhibiting effects, immune system stimulation, prevention of constipation, generation of group B vitamin, production of bacteriocins and inactivation some toxic compounds. Besides the traditional kefir and koumiss, the new products include among others: several yoghurt: Natural Light Yoghurt, OH BA Yoghurt.

Japan has been a pioneer in the area of functional foods and has already established for approving functional foods, granting such products individual health claims for specific health needs on approved and sufficient research data.

The others are: Pf 21 (from ASAHI BEER COMPANY) protein rich sport drinks that contains collagen; pasta rich in natural dietary fibre; snack rich in fibre (from Nissin Food products);sausage: Oligo Harmony - pork sausage with added oligosaccharides; Fibre Harmony - pork sausage with wheat fibre; Calcium Harmony - pork sausage with added egg shell calcium. The first functional foods in cereal products was YOSA^{R} . YOSA^{R} is a fermented oat brain snack . It was registered and introduced on the market in Finland 1995.Yosa[R] is a vellie: a cereal based snack type pudding fermented after cooking with probiotic bacteria and flavoured. It is stored and served cool, ready to eat like a snack or dessert.

As consider, amaranth, quinoa and pea seed all some of the attributes of functional foods.

FUNCTIONAL FOODS FROM PSEUDO-CEREALS

Amaranth is a pseudo-cereal plant originating from Central and South American Indians. The most common varieties are: Amarantus cruentus, Amartantus hypochondriacs, Amarantus caudatus and Amaratus edulis.

The protein content of amaranth is 16 - 20 %, the protein components are albumin and globulin 66%, prolamin 0,70% and gluten 28,5%. Its biological value 75. Starch content is between 50 -70% of which amylopectin can be almost 80 - 100 %. Its oil and fat content is approximately 8 %. Its oil content is rich in vitamin E and its Ca, K, P as well as Mg and Fe content is relatively high.

Amaranth seeds fulfil the requirements for functional foods in many ways. The prolamin type protein content of amaranth is low, therefore these seeds are suitable in the diet of people suffering from celiac disease, and emulsifiers are required to form the dough structure. In the presence of emulsifier an emulsifier-carbohydrate-protein-lipid complex can be expected. The rate of the individual interactions depends on the components of the given sample.

MATERIAL AND PREPARATION OF DOUGH SAMPLES

Amaranth flour and quinoa flour with rice flour (in a ratio 1:1) after extrusion was used in the study, which carried out in University of Vienna. The emulsifiers are presented in **Table 1.**

Table 1. *Type of emulsifiers applied*

Name		Company	Type
Amidan 250B Dimodan PM	A D	Grindsted, Denmark	>90 % saturated and unsaturated mono-and diacylglycerols
Multec SSL	S	Beldem Food Ingredients, Belgium	Sodium stearyl-2-lactylate
Multec Data	B	Beldem Food Ingredients, Belgium	Mono-and diacylglycerols tartaric acid ester
Epikuron 130-P VP-6108-10	E V	Lucas Meyer, Germany	Lecithin Lecithin + Lysolecithin

PREPARATION OF DOUGH SAMPLES

The amount of flour and water was counted for 40% moisture content in the model systems. The optimal amount of emulsifiers has 1 - 1,2% (calculated on a flour mass basis). Suspension was made from the emulsifier and water. The temperature of suspension was increased 97 °C. It was stirred for 15 minutes in the mixer. Fine and small pieces of dough were prepared by dough processing machine pressed through teflon matrix. The dough was dried at 39 °C and 87 % relative humidity for 24 hours.

METHODS

- Method of wet content, carbohydrate, protein according to Karácsonyi (1970)
- Method of cooking test was made according to Karácsonyi (1972, cooking time, wet volume, the amount of water uptake, cooking loss.
  The water : dough = 1 :1, tap water pH= 6,80 , electric cooker).
- Sensory assessment was carried out according to Hungarian Standard methods (1986).
- Iodine binding capacity was measured according to Conde Petit (1992)
- Electrophoreses were made according to Kovács (1998, PS 2000 instrument, 110 V, 45 mA, 110 min)
- Mini gels were used and stained for protein and carbohydrate according to Nedelkovits (1975).
- Protein fractions were separated according to Barba de la Rosa (1992)

RESULTS AND DISCUSSION

The results of the model systems were evaluated with mathematical statisatical method at P = 5% level. The amaranth pasta properties can you see on the **Figure1**. Good quality dough with excellent sensory assessment was obtained from amaranth flour with 1,2 % monoglycerid type emulsifiers, while applying lecithin type emulsifiers, the dough structure was less good : consistency value is worsening and the cooking loss is growing. Monoglycerid type emulsifiers result 60-80 % complexing rate, which suggest the presence of emulsifier - amylose interaction in the structure, while in the lecithin type of emulsifier there are hardly any components suitable for complex forming. The interaction is only between protein and emulsifiers.

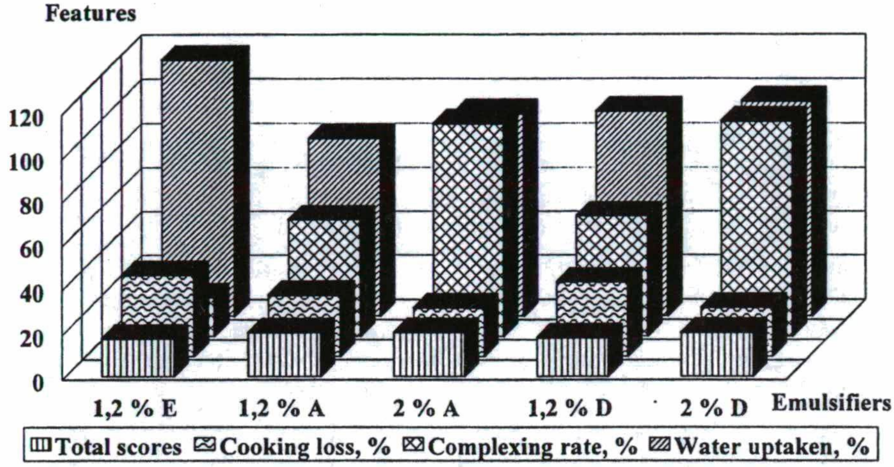
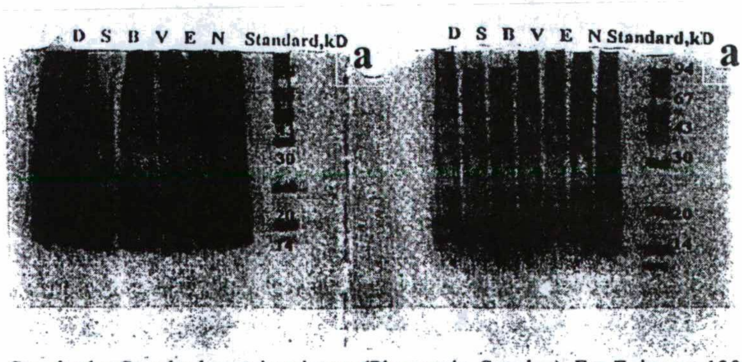


Figure 1. Characteristics features of amaranth pasta products made with different type of emulsifiers

The molecular weight distribution can you see on the **2. Figure.** Albumin and globulin fractions : 10, 22-24, 21-32, 36-38 and small number of molecular weight region under 58-60 kDa were obtained from native amaranth flour. When we applied emulsifiers the amount of albumin and globulin fractions diminished and there was a discrepancy in the distribution of fractions.

At Amidan 250 B there were only in the region of 13 kDa and a small of 20 kDa fractions. The emulsifiers Dimodan PM 1,2 and 2 % (D1 and D2) were applied fractions under 10 kDa and a small 22-24 and 38 kDa remained. There are capable only of forming electrostatic and H-bridge interactions. The Epikuron 130-P emulsifier type of lecithin, in this case the interaction has mainly a hydropbobic character: the subunits under 10 kDa and 22-24 kDa remained and the fraction 36-38 kDa was increased.

Albumin and Globulin **Glutenin**



Standard = Standard protein mixture (Pharmacia, Sweden), E = Epicuron 130 P, V = VP-618-10,
B = Multec Data, S = Multec SSL, D= Dimodan PM, N = no emulsifier

Figure 2. Electropherogram of soluble protein fractions made from amaranth flour with different emulsifier

We managed to demonstrate significant changes in glutelin fraction of amaranths pasta products. In natural amaranth flour protein fraction under 13 kDa was observable, but fractions 22-27, 34-37 , 54-57 and 68 kDa were dominant. When we applied monoglycerols type emulsifiers (Amidan 250 B and Dimodan PM) the amount of sharply different pattern diminished , aggregation occurred. The low molecular weight protein subunits vanished and different type of change caused by lecithin takes place: the fraction in between 10-37 kDa or due to aggregation, it remain at the starting point. If the separated protein (gel slab) is stained for carbohydrate, it can be seen to contain carbohydrate in different degree.

In albumin and globulin fraction the 13 kDa fraction on the influence of glucoprotein, emulsifiers only interactions under 20 kDa contain carbohydrate active components. Every subunit of active glutenin fraction contains a carbohydrate active component. In the monoglyceride type emulsifiers fractions 10 -34 kDa region are active, but in the Epikuron 130-P emulsifier under 13 kDa or fraction remains at the starting point.

Based on the results of electrophoretic studies it can be stated clearly that these interactions depend on the type of emulsifier. All used emulsifiers had an effect on the molecular weight distribution of protein fractions.

FUNCTIONAL FOODS FROM PEA

Pea seeds are rich in the components of functional foods and they do not contain substances causing celiac disease.

The protein content of peas is 16-25 %. The components of protein are albumin, legumin and vicillin. Its biological value is 64. It is a wellknown fact, all starches, including those from peas and other legumes are composed of two types of molecules, amylose and amylopectin. The starch content is 50 %, the amylose content is 40%. Pea seeds have a high level of dietary fibre, 19 %. The fat content is 0,8-1,3 %. It is high in oleic and linoleic acid, which is essential for human nutrition. The most important vitamins in pea seeds are thiamine, riboflavin, niacin, vitamin B_6, folic acid and β-carotene. The mineral and trace mineral composition is good: P, K, Na, Ca, Mg, Zn, Cu and Fe. Pea seeds do not contain gluten protein (gluten free) therefore emulsifiers are required to form the dough structure.

The emulsifiers interact with the proteins, carbohydrates and lipids. The proteins establish hydrophobic hydrophilic and hydrogen-bridge interactions with emulsifiers. In this way help to from a flexible network in the leguminous basic dough. The emulsifier - carbohydrate interaction can be a complex forming with amylose or a hydrogen-bridge with the amylopectin.

When developing new products, it is important to study the texture: sensory properties, rheological and mechanical properties, macro-, micro- and submicroscopic structure as well as the chemical composition. From this point of view it is important the forming of interaction between emulsifiers and the components of raw material.

We produced dough in model systems from different varieties of pea flour and type of emulsifiers. The optimal amount of emulsifiers 1 % (as calculated on flour mass).

In these systems we can imagine on protein-emulsifier, protein-carbohydrate and protein-lipid interactions occurring respectively. The results can be seen on **Figure 3, Figure 4 and Figure 5.**

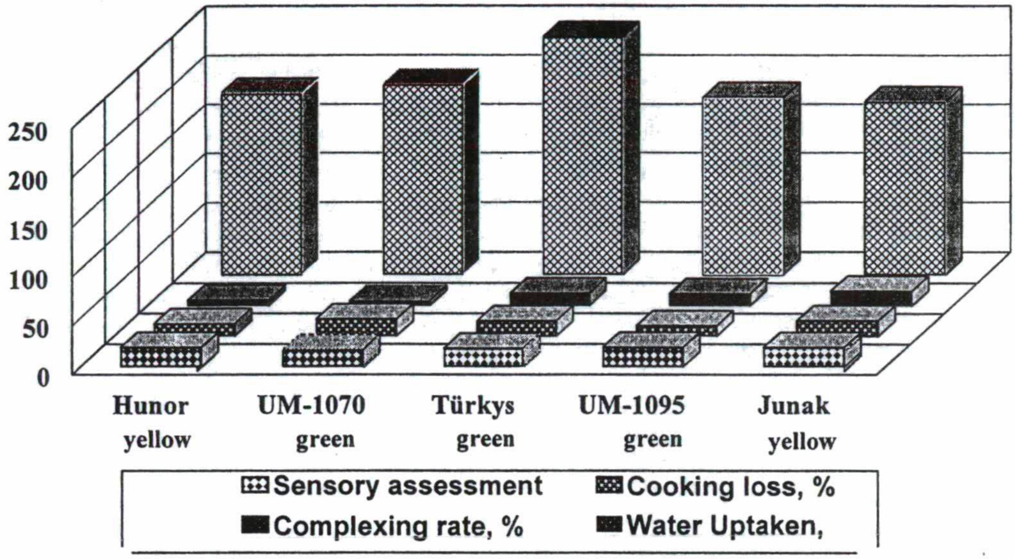


Figure 3. Cooking properties of pea basis dough made with lecithin emulsifier

The flours of pea varieties differ from one other in respect of their protein and amylose content. Pasta was made from HUNOR, UM 1093 and TÜRKYS pea varieties with different type of emulsifiers exhibited poor sensory properties, but the quality of the dough was first class. These pasta products had a high water uptake and low cooking loss. From the point of view of sensory assessment resulted in the UM-1095 and JUNAP pea varieties the best results. In these systems the structure was very good: the water uptake reasons able enough and the cooking loss low.

Monoglycerid type of emulsifiers Dimodan PM resulted in 69-91 % complexing rate which suggested the presence of amylose-emulsifier interaction in the structure. The amount of complexing rate was according to amylose content of the samples. But there are interactions between emulsifiers and proteins too.

In the presence of Epikuron 130 P the protein-emulsifier interaction has an important role in the forming of structure. In lecithin type of emulsifiers there are hardly any components suitable for complex forming. The complexity rate was very low 5-15 %.

The emulsifier VP-618-10 contains lysolecithin also, so the complexing rate is lower, than 48-66 %. In this system both protein-emulsifier interaction, emulsifier-carbohydrate complex were established.

The results of the electophoretic examination can be see on the figure 6. On the basis of electrophoretic pattern of salt soluble fraction we can see that in the presence of monoglycerid and lysolecithin a similar change in molecular weight distribution took place: the fractions processing molecular weight under 25 kDa decreased, that between 43-67 kDa was detected in mainly two patterns and the amount of fractions over 80 kDa did not change. In the presence of emulsifier lecithin, the fractions of 30, 55 and 60 kDa aggregated. The number of fractions was reduced, but the amount of fractions increased.

On the basis of electrophoretic pattern stained for carbohydrate, we observe new results. In the native samples of pea salt soluble proteins we observe active carbohydrate subunits of 43-60 kDa. The emulsifier aggregated the low molecular weight fraction into the protein network. In the presence of emulsifiers type of monoglycerid and lysolecithin we found carbohydrate active components in 30, 50 and 60 kDa molecularweight region, in the presence of lecithin we found this fraction in 40-60 kDa molecular weight region.

We were able to show the emulsifier-lipid-carbohydrate-protein complex. In the native samples and in the presence of emulsifiers the protein fractions of 30 kDa contained lipid fraction, but in the presence of lecithin the lipid fraction in 40-80 kDa was detected. The emulsifier lecithin could establish hydrophobe interaction and the molecularweight of this fractions was between 40-70 kDa. In this emulsifier we could not detect lipid fraction in the low molecular weight region. The lipid complex was connected in all pea varieties to the 40-80 kDa protein fractions in the presence of emulsifier lecithin.

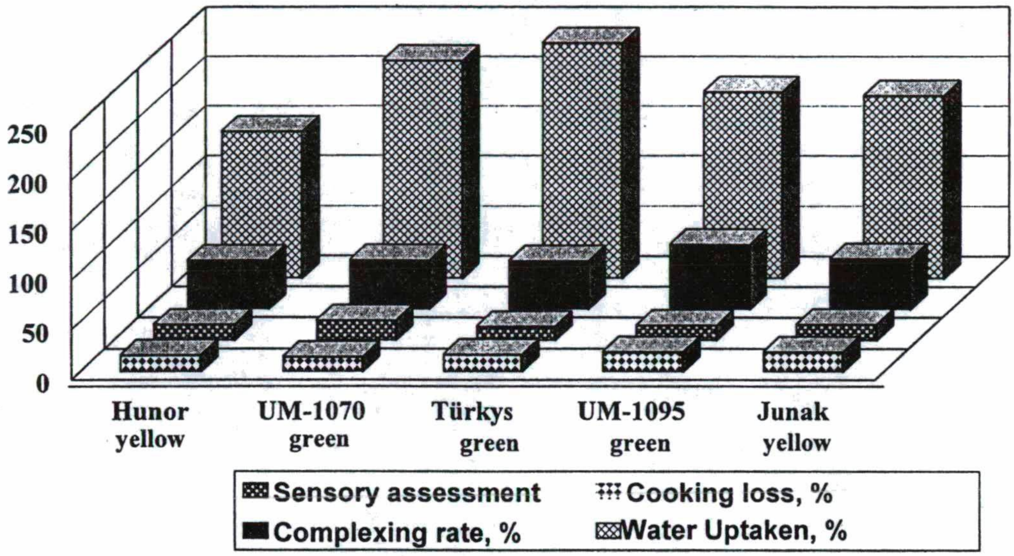


Figure 4. Cooking properties of pea basis dough made with lecithin and lysolecithin emulsifiers

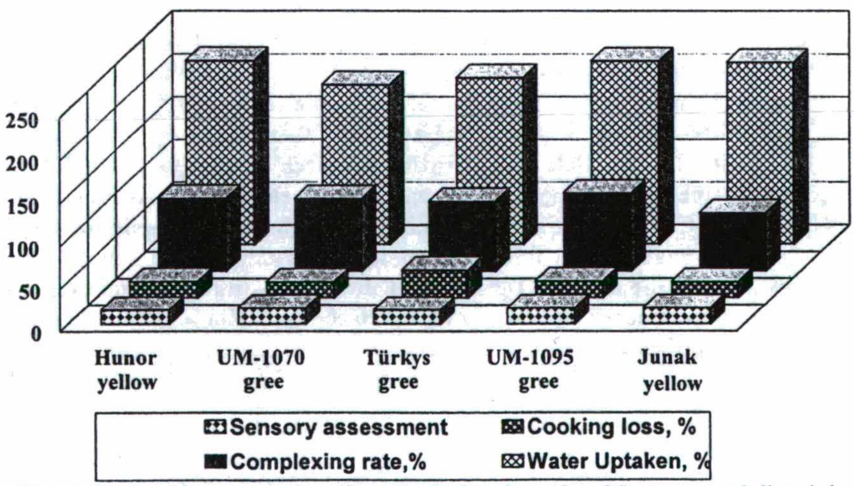


Figure 5. Cooking properties of pea basis dough made with mono- and diacylglycerols emulsifiers

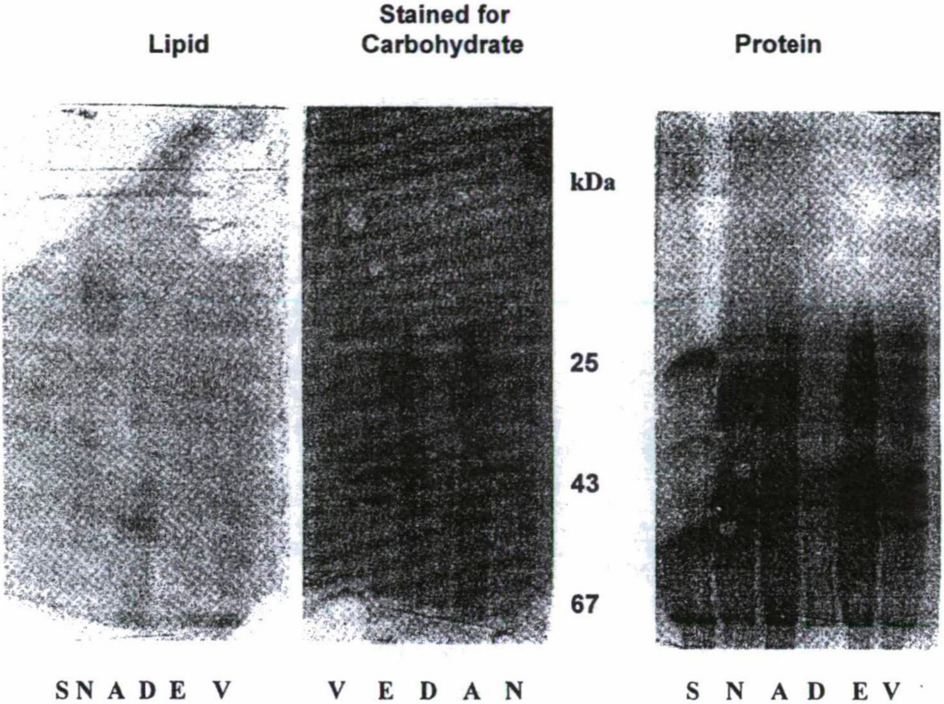


Figure 6. Electrophoretic pattern of Junak pea variety
S: Standard (Pharmacia Sweden, Mw= 25, 43, 67 kDa), N = Native,
A: Amidan 250B, D = Dimodan PM, E7 Epicuron 130 P , V = VP-618-10

ACKNOWLEDGEMENT

Many thanks for the opportunity of habitation process to the **Pannon University, Agricultural Science, Mosonmagyaróvár,** personally to **Dr. János Ivancsics,** head of the program; **Dr. Lászlo Dinya (to 1995) and Dr. Gábor Szabó (from 1996) Dean of Szeged College of Food Industry**; **Dr. Radomir Lásztity and Dr. János Varga, Technical University, Budapest; Dr. Éva Gelencsér, Central Research Institut of Food Industry, Budapest** as well as **the** many support for my scientific developing **Dr. Helmut Glattes, Secretary General of ICC , Vienna and Dr. Emmrich Berghofer, University of Vienna, and Dr. Werner Pfannhauser, Technical University of Graz, Austria ; Dr. C- Vidal Valverde, CSIS Madrid Spain and Dr. Roger Fenwick, Institut of Food Research, Norwich, UK** for the Common Research and EU- Porojects **and Klára Dobozi and Livia Süli** for the material of presentation.

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