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## ***Editorial***

**Faculty of Food and Tourism**

**At the 10 Years Jubilee: 2007-2017**

# **Vivat, crescat, floreat!**

At a decade since the creation of the Faculty of Food and Tourism within Transylvania University from Braşov, which is celebrating 10 years on the **18<sup>th</sup> of July**, we are entitled to declare that, all along this period of time, this faculty has proved its necessity and utility to the credit of its university community.

First of all, its **necessity**, because for the first time in Romania and rarely in Europe, the society has been offered the engineering solution for the tourism industry, integrally, but especially focalized, in relation to the alimentary act.

As a natural consequence, the Faculty of Food and Tourism has proved its **utility**, by forming generations of graduates with a high degree of preparation, of excellent performers bachelors in engineering, with thoroughgoing study towards creativity by MA and with “diamond grinding” in forming researchers, by PhD.

The concept of „food & tourism” is promoted through study programs from the *Engineering and Management* field and *Food Engineering* and as for diverse installations and equipments of this integrated field, there are continued the former *Mechanic Engineering* specialties.

But, even if for our life 10 years represent a lot, for a Faculty it is just a start; a good start that we see a better one in the future, knowing that “good” is the bad of “better”. Thinking of what is going to come, we may even hope to form a real school of technology in *Hospitality*, in *Travels* and in *Responsible Tourism* (tourism in relation to Nature, on direction of ecotourism and agro-rural tourism), but all this only under the conditions of a better responsible implication and spiritual fruitiness.

We do hope in the desire to continually develop the Faculty of Food and Tourism from Braşov and increase the good work in which we are all engaged in order to offer the professional attitude and university excellence creative power and perennality, wishing it:  
**Vivat, crescat, floreat !**

Publication Director,  
Prof. Romulus Gruia, PhD, PhD Supervisor





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# DATA MANAGEMENT FOR EVALUATING GERMINATION POTENTIAL OF COATED SOYBEAN SEEDS USING THERMAL IMAGING TECHNIQUE

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**Abstract:** Soybeans are coated before planting to protect from pests during germination. Though different coating materials have been suggested for protecting soybeans such as benzyladenine, calcium, antimicrobial agents, food additives, ozone water treatment and chitosan but it is important to provide information on effectiveness of these materials. A study was undertaken to use thermal imaging technique for developing a germination predicting model for soybean crops. A greenhouse trials were conducted on 15 sets of experimental units with twenty five seeds in each unit. Two commercial polymers such as Precise seed finisher 1010 and SeedWorxAgShine Blue were used a coating for this research. Thermal images were acquired with an ICI 9640 infrared camera with a spectral range between 7 $\mu$ m to 14  $\mu$ m and physical data were collected every day measuring the root and shoot length with a digital caliper. The thermal signatures were established and it was found that polymer coated seeds resulted in increasing the soybean sprouts health by imbibing water faster. The thermography has helped to identify the hypocotyl and radicle organ of germinated seeds with constant temperature difference. It was concluded that the temperature difference between seeds in the initial stage of the swelling process during germination gives a direct measure of the seed germination potential with the aid of thermal imaging.

**Keywords:** Thermal Imaging, Data Management, Soybean Germination, Polymers Coating

## 1. Introduction

Soybean suffers attacks of various pests that result in considerable crop losses during germination and growing steps [1] [2]. Different coating materials have been suggested for protecting soybeans such as benzyladenine [3] calcium [4], antimicrobial agents [5] [6], food additives [7], ozone water treatment [8], and chitosan [9] [2]. However, none of these materials have been used successfully, and there is still need to do more research with different kind of coating materials. Successful coating for soybean seeds will have many other advantages other than protecting the seeds from pests. It can protect the soybean seeds during transportation and handling, and during the planting operations while improving the soybean seed appearance. Gesch et al., [10] demonstrated that using polymer-coated seed reduces the risk of poor soybean emergence in conservation tillage. It has

been proposed that seed coatings can protect the seeds such as soybean when planted in cold, wet soils [11]. Zeng et al., [2] demonstrated the positive effects of using acetic acid as a fungicide treatment for soybeans. The effect of polymer coat with acetic acid on soybean seeds on germination will be studied in this research. Detecting the germination potential of seeds with thermal imaging will provide a fast method to choose seeds prior to field trials [12].

Even seed breeders will be able to evaluate the germination potential of the seeds quickly without performing the time-consuming germination trials. There has been a great interest in identifying and developing new methods to study the plant phenotyping non-invasively. This includes coupling of nonconventional optical imaging with computer vision as a tool to obtain an automated plant phenotyping. Such tools are believed to be performing much better than human eye and becoming a source for functional



imaging [13]. Thermography is one such non-invasive imaging method which works on the principle of Planck's law, which describes the luminance of a black body in thermal equilibrium at a given wavelength, to measure temperature. Thermal imaging has been used to study the defects in stomatal regulation in *Arabidopsis* mutants [14], plant water content [15], plant damage in freezing temperatures [16], and in detection of scab spots in fruits [17]. Thermal imaging has also been reported to successfully detect the biophysical and biochemical changes in seeds during imbibition and germination to predict whether the dormant seeds will germinate or die after uptake of water [18]. The objectives of this project was to study the effect of coating on soybean germination, and to develop an algorithm model to predict the germination potential of coated soybean seeds using thermal imaging technique.

## 2. Materials and Methods

### 2.1. Seed Coating

Soybean seeds were coated with a rotary pan technology using a tabletop lab seed treater (USC Seed Treating Solutions, Sabetha, KS, USA) with the two commercial seed coating polymers as follows: Polymer 1- Precise seed finisher 1010 (Bayer CropScience, Durham, NC, USA), and Polymer 2 - SeedWorxAgShine Blue (Aginnovation LLC, Walnut Grove, CA, USA). Both of these polymers are designed to increase the water uptake potential of seeds and to increase the flowability of the seeds inside the planting equipment. A total of five treatments were obtained by coating: Polymer 1, Polymer 1 + 1% Acetic Acid, Polymer 2, Polymer 2 + 1 Acetic Acid, and raw soybean seeds as a control. For each coating treatment, 1:1 (w/w) of seeds and polymer was used. The coated seeds were dried at room temperature until no change in mass observed to ensure full drying. To check the water uptake potential of the 5 abovementioned treatments, seeds were placed in petridishes lined with water saturated germination paper (Anchor Paper Company, Saint Paul, MN, USA). Three replicates for each treatment with 25 seeds per treatment were used for this experiment. Weight of imbibed seeds were taken at the following time intervals: 2, 6, 12, 24, 48, and 72 h. Weight of raw seeds and imbibed seeds were used to calculate the percent water imbibition.

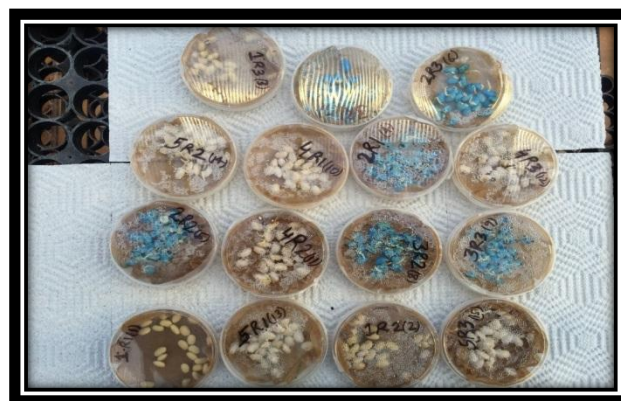
### 2.2. Greenhouse Trials

Greenhouse trials were conducted for all the 5 treatments with 3 replicates each in the greenhouse situated in North Dakota State University campus as showed in fig. 1. Twenty-five seeds from each treatment were sown in petridishes lined with water saturated germination paper. Data was collected every day measuring the root and shoot length with a digital caliper. Germination counts are recorded and classified as normal and abnormal seedlings according to the germination guidelines for soybean seeds by AOSA rules for testing seeds.

### 2.3. Imaging

#### 2.3.1. Thermal imaging

Thermal images were acquired with an ICI 9640 infrared camera with a spectral range between 7 $\mu$ m to 14  $\mu$ m, a pixel resolution of 640  $\times$  480, a 14-bit dynamic range, thermal sensitivity of less than 50mK, and an accuracy of  $\pm 1$  C. Seed imbibition rate plays as an early stage essential factor for seed germination. Several studies have shown coloration between seed temperature changes and seed imbibition. Preliminary potential capacity of treatments seeds germination evaluated based on temperature distribution of their surface seeds during the first hours of the swelling.



**Fig.1.** The total number of treatments with three replicates set up in greenhouse

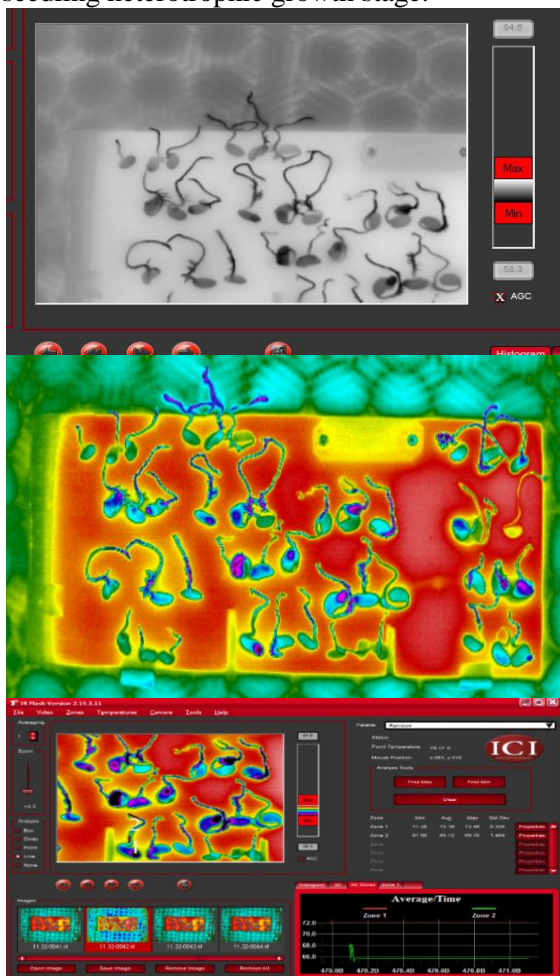
The radiation temperature differences between treatments show imbibition phase metabolic process after swelling as shown in fig. 2. These changes are so useful to evaluate seed germination and also indicate which seeds are more intensive affecting temperature differentiation. For water imbibition tests, the thermal images were taken at first hour in every minute and also one day after sowing hourly. Seed elongation is an early stage of the

development of plants. The rates of elongation depend on species and genotype besides environmental conditions.



**Fig. 2.** Thermal image of the seed swelling process.

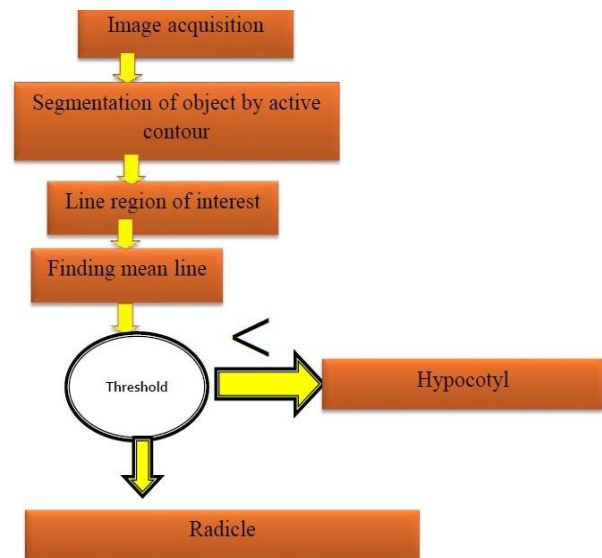
Large fluxes of metabolites move from the storage organs to the elongating zones, mainly the upper part growing towards the soil surface at seedling heterotrophic growth stage.



**Fig. 3.** Identifying seed hypocotyl and radicle by thermal imaging

While the elongation radical also receives metabolites from seed reserve hydrolysis, and absorb water and minerals from the growth support at this time. From this physiological

point of view, the difference temperature between radicle and hypocotyl was measured to evaluate thermal discontinuity as a discrimination factor between seedling organs (fig. 3).



**Fig. 4.** Steps of algorithm development for identifying hypocotyl and radicle length

The steps of algorithm development to identify the hypocotyl and radicle length are shown in fig. 4.

### 2.3.2. Digital RGB Imaging

Germination is usually represented by a cumulative curve where the completion of radicle protrusion is polled as a function of time in a population of individual seeds following imbibition. Therefore RGB images from each treatment were collected by Sony NEX 5R camera daily. Seed elongation was measured by image processing method with the Fiji image processing package based on image J. Images were first imported to the Image J software and then threshold value was applied to differentiate the shoot from the background followed by setting the scale, and finally the length measurement using the scale set up in the previous step as shown in fig. 5.

To identify germinated seeds, 2mm elongation of seed root was as an indicator for germination. Radicle elongation stages of germination was measured by image processing developed algorithm and compared to manual measuring.

### 2.3.3. Statistical Analysis

The data was analyzed using analysis of variance, and an F-protected LSD ( $P \leq 0.05$ ) was



calculated for comparisons of main effect means by using MINITAB 17 software.



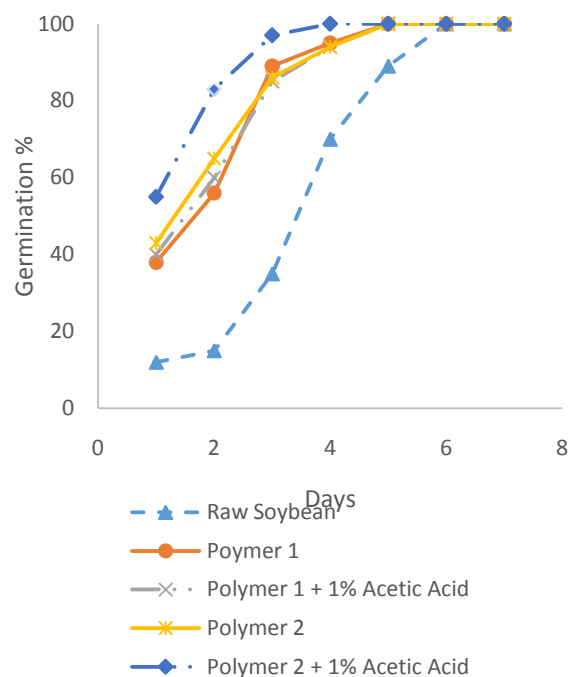
**Fig. 5.** Steps for the length measurement using RGB Imaging

### 3. Results and discussion

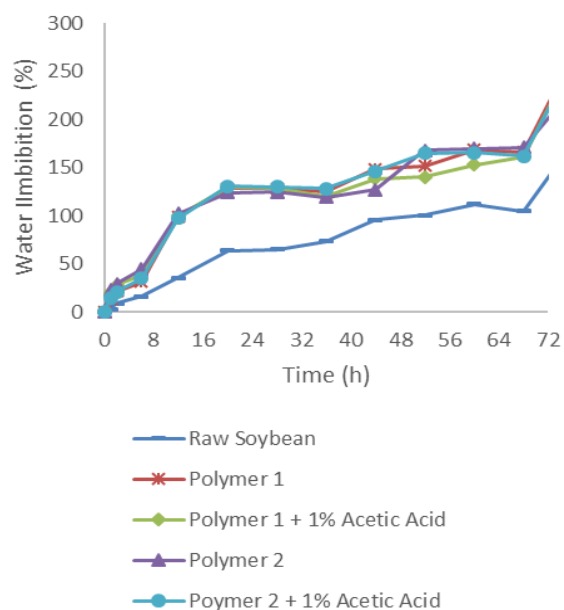
#### A. Germination and Water Imbibition

The water imbibition test was conducted to determine the water absorption potential for all the five treatments for 3 days. During the first 6 h, the raw soybean seed absorbed the least amount of water (17%) as compared to all the 4 coated treatments: Polymer 1 (32%), Polymer 1 + Acetic Acid (39%), Polymer 2 (45%), Polymer 2 + Acetic Acid (35%). The similar trend continued throughout the 3 d time interval, where the water imbibition percent for raw soybean seeds was 79

% less as compared to the averaged water imbibition percent of all 4 coated treatments (fig. 8). The water imbibition percent directly affected the seedling germination; more the water imbibition percent, faster the seedling emergence (fig. 6 and fig. 7). The raw soybean seeds resulted in only 12% germination; whereas, all the coated treatments resulted in greater than 80% germination at the end of 3 d.



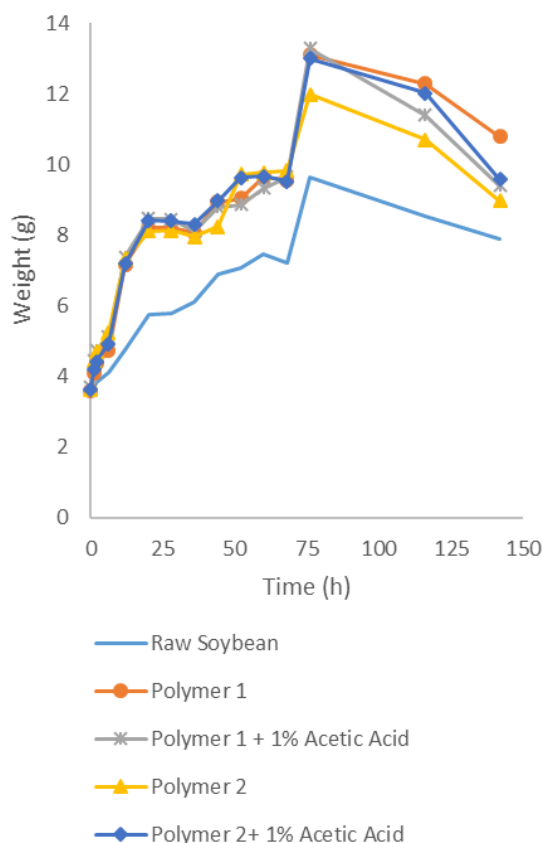
**Fig. 6.** Effect of coating treatments on soybean seed germination



**Fig. 7.** Effect of coating treatments on water uptake potential of soybean seed

Furthermore, the seedlings emerged from the coating treatments resulted in statistically higher weights as compared to the raw soybean seeds at the end of 3 and 7 d. When averaged across all the time intervals from day 1 to day 7, all the coated treatments resulted in 2 g higher weight than the raw soybean seeds (fig. 8). No and co-authors (2003) observed the similar trend of improving soybean sprouts health by the chitosan treatment on soybean seeds.

For both Polymer 1 and Polymer 2, addition of acetic acid did not result in statistically significant germination percent, water imbibition percent, and seedling weight. This suggests that the polymer helps in absorbing the moisture faster, and thus improves the quality of soybean sprouts; furthermore, addition of acetic acid as a fungicide did not affect the both the germination and seedling weight.



**Fig. 8.** Effect of coating treatments on soybean seedling weight

### B. Thermal Imaging

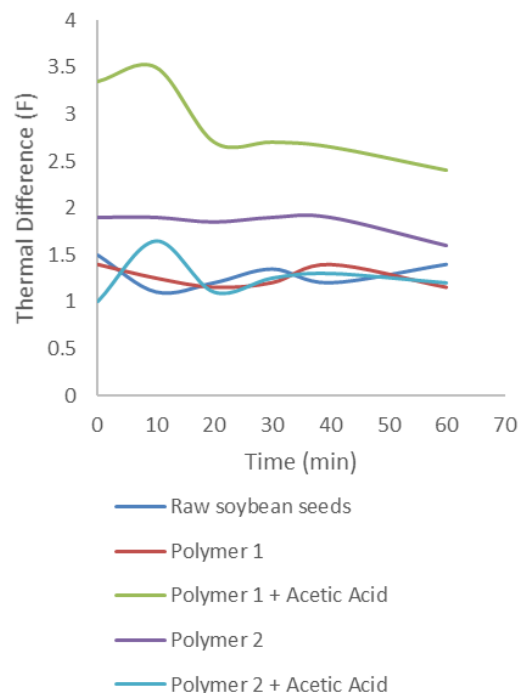
The robustness of the thermal difference during the seedling growth was observed in fig. 9. The thermal gradient along the seedling was observed at the beginning and end of the hypocotyl organ. Polymer 1 + 1% acetic acid coated seedlings

exhibited the highest thermal difference between the radicle and hypocotyl followed by the polymer 2.

The other treatment seeds showed similar trend with the thermal difference during the first hour. The higher the thermal difference the better is the length elongation of both root and shoot of the seeds. When statistical analysis was performed using one way ANOVA followed by the Fisher's LSD for the multiple comparisons, polymer 1 + 1% acetic acid treatment was significantly different from all of the other treatments.

The polymer 2 treatment was also significantly different from other treatments, but there was no significant difference observed between the other four treatments at 60 minute time interval.

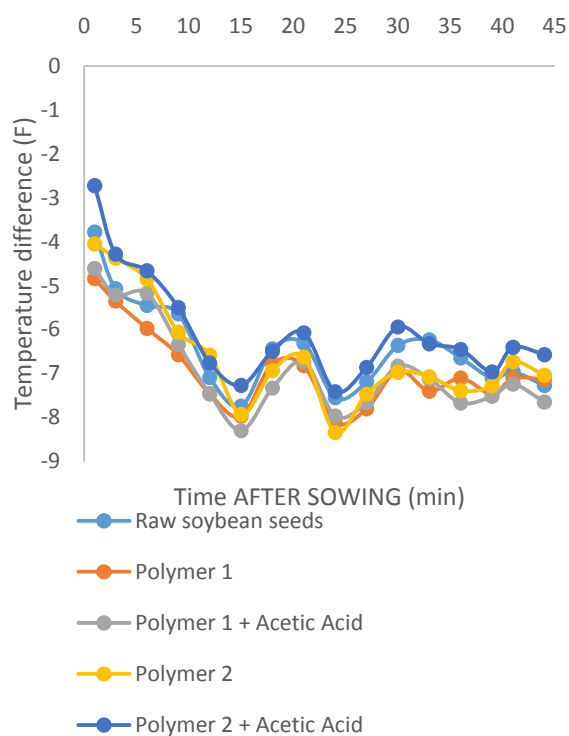
Smaller differentiation of temperature shows limited germination capacity while high level germinated seeds show larger temperature differentiation.



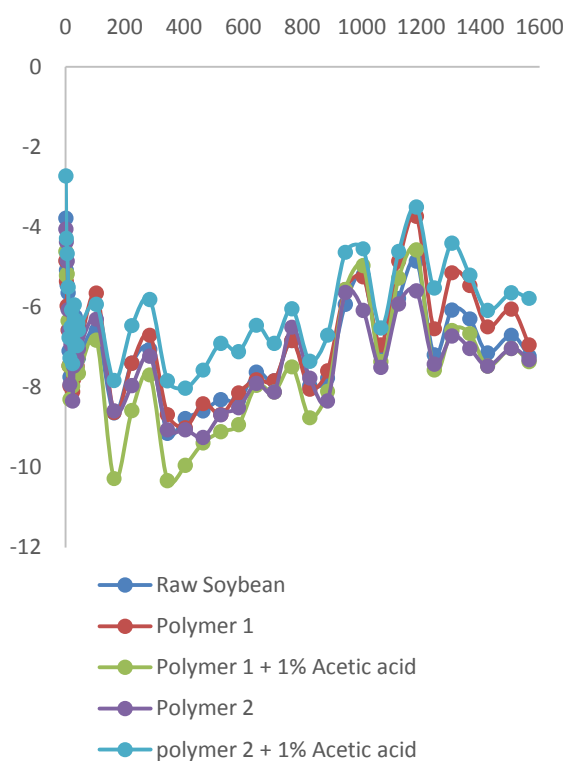
**Fig. 9.** Time evolution of the difference of temperature ( $Thyp - Trad$ ) between seedling organs (radicle and hypocotyl) during time

The change in the radiation temperature of the seeds in the first imbibition (44 minutes) was observed in fig.10. All the treatments showed lower temperature compared to the ambient temperature. The raw soybean seeds showed the least temperature difference when compared with the coated treatments but it was not significantly different to other treatments.





**Fig.10.** Changes in radiation temperature of soybean seeds in the first 45min of the swelling process



**Fig. 11.** Evolution of soybeans seeds temperature during imbibition

This further illustrates that the coating treatment proved beneficial for seedling health. The thermal signature of fig. 11 displays a larger variation of temperature for higher temperature of the water and larger surface of contact between the water and the seed.

This is made possible by maximizing the surface contact between the seeds and the water supply. The statistical analysis performed at 824 minutes showed polymer 2 alone and in combination with 1% acetic acid absorbed moisture was significantly different from other treatments. But at 1600 minutes, only polymer with 1% acetic acid found to be significantly different from the other treatments.

## Conclusions

The study was undertaken to evaluate the germination potential of coated seeds and concluded that polymer coated seeds resulted in increasing the soybean sprouts health by imbibing water faster. Furthermore, addition of acetic acid did not adversely affect the germination and seedling health. This study suggests that the addition of acetic acid during the coating process will protect the seeds from pests while improving the seedling health; however, field trials are necessary to support this conclusion.

With the aid of thermography, the hypocotyl and radicle organ of germinated seeds are identified by the constant different temperature between these two organs. Furthermore, this study concluded that the temperature difference between seeds in the initial stage of the swelling process during germination gives a direct measure of the seed germination potential with the aid of thermal imaging.

## ACKNOWLEDGEMENTS

The authors would like to acknowledge support of Bioimaging and Sensing Center at North Dakota State University (NDSU), on this project. We would also like to thank Sandy; technician at the plant sciences, NDSU, for providing us the soybean seeds, and for the space given in the greenhouse to conduct the experiments.

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# STUDIES ON USING HEMP SEED AS FUNCTIONAL INGREDIENT IN THE PRODUCTION OF FUNCTIONAL FOOD PRODUCTS

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**Abstract:** The paper studies the possibilities of using hemp seeds for functional ingredients in food products. Here is a brief history of the concept of functional food, a synthesis of Categories of Health Mentions (Function) and Examples of functional ingredients. Importance of hemp seed in human nutrition results especially from the content of saturated and unsaturated fatty acids in hemp seed oil. Hemp seeds are an important source of oil, of high nutritional value, the content of linolenic acid being 56.35% and the one in alpha-linolenic, 17.30%. Total content in unsaturated fatty acids exceeds 85%. Here is a comparison between the content of omega 3 and omega 6 from different sources, a protein characterization and a statistics of the main hemp producers highlighting the significant contribution of hemp seeds as a functional ingredient in this regard.

Over the past decade, there has been a significant change in the scientific approach adopted by many food scientists on the relationship between sensory attributes and physico-chemical properties on the one hand and the physiological performance of food on the other. In particular, there has been an increase in awareness of the complex relationship between the structure of foods and their nutritional performance.

To date, most research on functional foods has focused on the nutritional composition of the food product and to a lesser extent on the effects of adding a bioactive compound to the texture and product quality. Demonstration of success and efficiency of incorporation of bioactive components into selected food matrices is important for the marketing of new bioactive components and functional food ingredients.

**Keywords:** functional food, hemp seed, antioxidant.

## 1. History of the functional food concept

The modern concept of functional food for the population was generally proposed by the Japanese academic society in the early 1980s. Studies and research were conducted to identify those healthy components, ultimately resulting in the concept of "functional foods". Since 1984, large-scale research has been carried out on food functions under the aegis of the Ministry of Education, Science and Culture of Japan [2].

A number of Japanese researchers in the fields of food science, nutrition, pharmaceuticals and medical sciences have participated in these research and many interesting features of food components have been identified with regard to their physiological functions [2, 3].

The results of these research have led to the world's first policy to allow the marketing of foods with certain health promotion functions. These special foods have been called FoSHU (Foods for Specific Health Use). The FoSHU system was introduced in Japan in 1991 by the Ministry of Health and Social Protection as a regulatory system to approve the mentions of the effects of food on the human body. In this regulatory system, FoSHU is classified as a special food group between medications and regular foods.

The first FoSHU products were approved in 1993 and included hypoallergenic rice and low-phosphorus milk for certain categories of patients. Since the FoSHU should not include medical requirements such as "prevent," "cure" or "treat" human diseases, the products

mentioned above were subsequently transferred from the FoSHU category to another category called "food for the disease" [11]. Despite some regulatory errors in the initial stages, the FoSHU system has been encouraging the Japanese food industry to develop functional food.

The FoSHU concept was introduced in the journal *Nature* in 1993, and since then, the term functional food has been recognized internationally [15].

In 2001, the FoSHU criteria were integrated into the "Health Nutrition Foods" System (FHC). FHC is the Japanese regulatory system for health food products and is made up of two categories: FoSHU and Nutrition Food Products (FNFC;) [16].

FNFC allows use of these functional requirements for nutrients such as vitamins and minerals. Twelve vitamins (vitamin A, B1, B2, B6, B12, C, D, and E, biotin, pantothenic acid, folic acid, niacin) and five minerals (calcium,

iron, magnesium, copper, zinc) were permitted for FNFC. Labeling of nutritional functions for these vitamins and minerals is allowed because the benefits of taking these items from food have been recognized internationally, based on scientific pedagogy. The maximum and minimum daily nutrient doses for an individual were determined as the standard daily dose. Therefore, an FNFC product should contain a quantity of nutrients between the designated upper and lower limits [16].

Since March 2013, 1037 FoSHU products have been listed. Table 1 shows the approved FoSHU categories in Japan; These include foods that (1) improve gastrointestinal health, (2) promote the health of teeth and gums, (3) increase mineral absorption, (4) promote bone and power health, (5) reduce blood pressure, (6) Lower blood glucose levels, (7) lower cholesterol levels in the blood, and (8) lower blood triglyceride levels and reduced fat accumulation in the body.

**Table 1.** FoSHU categories and their corresponding functional ingredients [11]

Categories of Health Mentions (Function)	Examples of functional ingredients
Promotes bowel health	Dietary fibers, oligosaccharides, bacteria
Promotes the health of teeth and gums	Tea polyphenols, milk proteins, funoran, isoflavones, calcium
Improves the absorption of minerals	Casein phosphopeptide, poly- $\gamma$ -glutamic acid
Promotes the health of bones and power	Milk proteins, isoflavones, vitamin K2
Lowers blood pressure	Food protein peptide derivative, $\gamma$ -amino butyrate, acetic acid, chlorogenic acid
I lower blood glucose levels	Non-digested dextrin, wheat albumin, tea polyphenols, fermented soybean extract
Reduces cholesterol levels in the blood	Soy protein, chitosan, low molecular weight alginate, phytosterol, tea catechins, methyl cysteine sulfoxide
Reduce the level of neutral lipids in the blood and body fat	Polyphenol conjugates, non-digested dextrin, catechins, conglycinin, n-3PUFA

The underlying mechanisms for current FoSHU products are diverse. Even in the same health claims, various functional substances with different mechanisms of action may be included.

## 2. Importance of hemp seed in human nutrition

*Cannabis sativa* L., is a plant from the Cannabaceae family, known as 'hemp', it has been cultivated for thousands of years in Asia, Africa, Europe and has an important source of textile fibers in traditional medicine for the production of oil and food products [4].

In the twentieth century, hemp cultivation was banned for human consumption in many countries due to the presence of a phytochemical component considered to be a drug, delta-9-tetrahydrocannabinol (THC) [12].

The two varieties of hemp cultivated worldwide are *Cannabis sativa* L. and *Cannabis sativa indica*. The major difference between the two types of plants is the appearance and amount of delta-9-tetrahydrocannabinol (THC). Usually, hemp (*Cannabis sativa* L.) contains under 0,3% THC, while varieties of *Cannabis indica*, grown for use as a drug may contain from 2% to over 20% THC. Today in the European Union, 26 hemp varieties with low levels of tetrahydrocannabinol (THC), are certified to be cultivated (Directive 2002/53 / CE, Article 17). *Cannabis sativa* L. the non-drug variety and its seeds (hemp seed) are a significant source of dietary oil, fiber, minerals and protein.

Oil extracted from hemp seeds is recognized as an important source of essential fatty acids and is used as an ingredient for body creams, detergents and soaps. Recent clinical studies have identified



hemp seed oil as a functional food, and studies on animal feed have demonstrated the usefulness of hemp seeds as an important nutrient resource [4, 12].

Hemp seed oil is rich in polyunsaturated fatty acids (linoleic and alpha-linoleic) that can reduce cholesterol and blood pressure levels and provide immune support [13]. Moreover, hemp seeds are also rich in protein [10]. The two main hemp proteins are albumin (33%) and edestina (65%), which have very similar structures to blood proteins, so they have a slight digestibility. In addition, hemp seeds contain essential amino acids, including a high level of arginine amino acid [4].

From a nutritional point of view, it is known that there is a balance in the daily consumption of omega-3 acids and omega-6 fatty acids, and that of these, the only ones essential for human health are linolenic acid (LA, 18: 2n -6), an omega-6 fatty acid, and alpha-linolenic acid (LNA or ALA, 18: 3n-3), an omega-3 fatty acid. The

optimal LA and LNA ratio for human nutrition is considered by some researchers, 2:1, according to nutritional studies [14], other studies have suggested that this ratio is 1: 1 [5, 14], or after other researchers is about 3 parts LA to one part LNA, probably the best estimation [6].

The optimal ratio of LA and LNA of 3: 1 suggested by nutritional studies is very similar to that of the two essential fatty acids in hemp oil, even though hemp oil is not considered to be an important source of hemp oil. These essential fatty acids for human nutrition, since no nutritional research has been carried out on hemp in the last 65 years.

In table 2 It is possible to compare the typical unsaturated fatty acid profiles of the most common food oils with high levels of both LA and LNA (hemp, rapeseed, soybean and flax seed oils). It can be seen that hemp seed oil is recommended for human consumption in terms of the ratio of omega 3 fatty acids to omega 6.

**Table 2.** Content of omega 3 and omega 6 from different sources

Product	LA	LNA	LA/LNA Report
Hemp seed oil	55	20	2.8
Rape seed oil	22	12	1.8
Soybean oil	51	7	7.3
Linseed oil	15	61	0.3

**Table 3.** Fatty acid content of hemp seeds [17]

Component	Value
Oil content, %	28,7
<b>Saturated fatty acids</b>	
Palmitic acid (C 16:0)	6.96
Stearic acid (C 18:0)	2.74
Arachidic acid (C 20:0)	0.77
<b>Total saturated fatty acids</b>	<b>10.47</b>
<b>Unsaturated fatty acids</b>	
Oleic acid (C 18:1 ω 9)	13.64
Linolenic acid (C 18:2 ω 6)	56.35
Gamma-linolenic acid (C 18:3 ω 6)	1.35
Alfa-linolenic acid (C 18:3 ω 3)	17.30
Stearidonic acid (C 18:4 ω 3)	0.50
Eicosenoic acid (C 20:1)	0.39 NS
<b>Total unsaturated fatty acids</b>	<b>89.53</b>

In table 3 the content of saturated and unsaturated fatty acids in hemp seed oil is presented. It can be seen that hemp seeds are an important source of oil, of high nutritional value, the content of linolenic acid being 56.35% and the one in alpha-linolenic, 17.30%. Total content in unsaturated fatty acids exceeds 85%.

Hemp seeds also contain a considerable amount of protein, which is considered "complete" in the sense that all essential amino acids are present in important nutrients.

In table 4 the values of amino acid content of hemp seeds are presented.

These proteins are made up of about one third albumin, an important protein that is also found

in egg white and human blood, and two-thirds of ED, another important globular protein of similar character. Unlike soybeans, which contain trypsin, inhibitory factor, the hemp seeds are easily digestible for the human body. Vitamins and minerals of biological importance are found in hemp seeds. Hemp seeds have an important fiber potential.

From the above, it can be seen that industrial hemp seeds (*Cannabis sativa* L.) offer quality nutrients, especially amino acids, which could be extracted for use as substances with therapeutic potential in the management of chronic human diseases. Recently they have been conducted studies of antihypertensive properties and the antioxidant effect of protein hydrolysates in hemp seeds [9].

[1] have performed biological tests to determine the sequence of active peptides from hemp seeds that produce antioxidant and

antihypertensive effect. In vitro and in vivo studies in rats have shown that isolated peptides from hemp seeds have the potential to be used as antioxidant and antihypertensive agents.

### 3. Consumption of products with hemp seed intake

As mentioned earlier, hemp (*Canabis sativa* L.) has its origins in Asia and has been known for millennia. According to Dewey [7], hemp was first grown for fiber and later for seed. Its cultivation began in China in 2800 BC. From China it spread to India and Persia, and then came to Europe. In the middle ages, hemp has been extensively cultivated in Europe for its use as fiber, and its seeds have been cooked with other cereals for consumption.

**Table 4.** The content of protein substances of hemp seeds [17]

Component	Value
Protein content, %	24,8
<b>Amino acids,% dry matter</b>	
<b>Essential</b>	
Arginine	2.23
Phenylalanine	0.92
Histidine	0.56
Isoleucine	0.81
Leucine	1.41
Lysine	0.77
Methionine	0.09
Threonine	0.70
Valine	0.96
<b>Total</b>	8.44
<b>Nonessential</b>	
Alanine	0.92
Asparagine	1.96
Cysteine	0.24
Glycine	0.86
Glutamine	3.17
Proline	0.41
Serine	0.98
Tyrosine	0.52
<b>Total</b>	9.06
<b>Total amino acids</b>	17.50

It seems that for the first time the hemp was cultivated in America by Spaniards who started cultivating it in Chile since 1545 [8]. Approximately 100 years later it was introduced in the US, in New England [7]. Although hemp has been grown since antiquity, today it is not a large oil crop, with the production of hemp seeds worldwide at around 53,354 tons in 2008 (Table 5).

Production of hemp seed has decreased since 1970, with the exception of China, which is the main producer of hemp seeds. In Europe, the countries still producing hemp seeds are: France, Ukraine, Hungary, Russia, Poland and Romania (Table 5).

**Table 5.** Large producers of hemp seeds between 1961-2008 (tons) FAOSTAT 20/02/2010

Country	1961	1970	1980	1990	2000	2008
Chile	3000	2500	1100	1100	1100	1300
China	27 000	48 000	42 000	25 000	26 000	45 000
France	900	523	2680	1100	5500	5500
Hungary	1309	524	1664	1191	50	450
Italy	855	40	3	0	0	0
Polond	4000	2000	280	98	15	20
Romania	400	1200	1800	3000	25	100
Russia	-	-	-	-	250	331
Spain	2171	45	146	17	8	8
Ukraine	-	-	-	-	1500	600
URSS	30 000	20 000	10 000	2700	-	-
RFS Yugoslavia	2500	1500	177	196	-	-
EU	11 648	5817	6855	5445	5598	6078
In the world	79 748	80 448	64 741	35 291	34 591	53 354

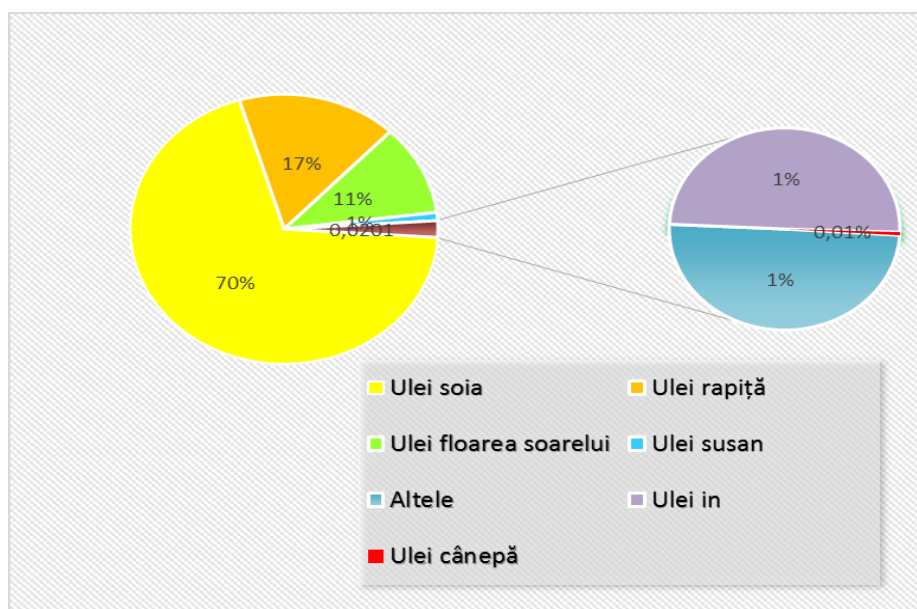
Worldwide, the oilseed market is dominated by soybean oil, rape and sunflower oil (Fig.1).

A hemp cultivation strategy for seed production is diametrically opposed to that of its cultivation for fiber production, since, historically speaking, hemp cultivation has been made, primarily for the production of fiber. In China, roasted hemp seeds are sold in markets, but large quantities of them are exported (not fried) as feed for birds. In the eastern part of Europe, hemp seed oil has been used as a substitute for butter, usually by those who could not afford dairy products. As a result, "hemp" seed oil was developed as a

delicacy in these regions [4]. At the end of the 1930s, hemp seed oil was used as a base in the paint industry.

Since hemp seeds have a pleasant hazelnut flavor and can easily be incorporated into nutritious foods, a current of hemp-derived food has recently developed in Western Europe.

Briefly, information on the potential of hemp seed products has not yet been attracted and, for a few years, in-depth studies have been published and recognized on the nutritional benefits of hemp seed.

**Fig.1.** Oil production from different sources of oil in 2008 (tons) [10]

Thanks to these researches in recent years, consumers in Europe and North America who are concerned about health and the quality of their diet have already created a significant demand for

hemp seed oil. In Romania hemp seeds are very little used (table 5) especially for oil, which is used as a raw material for obtaining food supplements.



## Conclusions

In the context of economic and social progress, human health is becoming an increasingly important personal and social value.

Because of the costs associated with curative medicine, prevention of emerging health problems is very important. That is why we need a new orientation in the study of the relationship between man and food.

The purpose of these scientific researches was to identify solutions to improve the nutritional level of the population by developing new functional bakery products with the potential to be consumed daily by a large segment of consumers.

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# THE ROLE OF GREEN BUILDINGS IN THE IMPROVEMENT OF THERMAL AND PSYCHICAL COMFORT FOR THE RESIDENTS OF BIG CITIES

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**Abstract:** This paper approaches a current issue confronted by the residents of large urban areas, where the cumulative effects of global warming pollutants, dust and noise produced by everyday activities create a permanent discomfort and represent a real threat to their health. One of the solutions for diminishing these effects is the greening of the cities, which is a concept campaigned by many national and international bodies and organizations. This idea can be put into practice through the construction of greenhouses on the roofs of the buildings. Thus, the positive effects of greening the cities are manifested not only by reducing the temperatures during the summer time, air filtration and retention of a significant quantity of pollutants and dust, reducing the intensity of noise, but also by providing a psychological comfort beneficial to people's health.

**Keywords:** global warming, greening buildings, uncontrolled urbanization.

## 1. General views on the emergence and the development process of global warming

The main cause of the global warming was generated by the increase of the concentration of CO<sub>2</sub>, NH<sub>4</sub> and N<sub>2</sub>O in the atmosphere in recent centuries [6]. Before the industrial revolution the concentration of CO<sub>2</sub> was 280 ppm. Nowadays is 400 ppm, which is nearly double and is predicted to be 550 ppm in 2035, if the flow of current emissions of greenhouse gases (GHG) would persist beyond the natural capacity of absorption. In this scenario, in the immediate period the average increase in temperature will be more than 2°C. This prediction is generated based on the rapid growth of the economies of China, India, Brazil, Australia, South Africa, Eastern Europe etc., the fact that the USA has not yet ratified the Kyoto Protocol and that the replacement of fossil fuel with renewable and clean sources of energy is progressing slowly.

The main factor underpinning the global warming process is considered to be the greenhouse effect, which is the term used to highlight the contribution of certain gases emitted naturally or artificially warming the earth's atmosphere by changing the permeability of the atmospheric solar radiation reflected by the earth's surface. This phenomenon was discovered by Joseph Fourier in 1824 [25].

If the Earth's atmosphere, the greenhouse effect warming was responsible enough to allow the development of its plants as we know them today. The main cause of this effect is the enormous amount of carbon dioxide and other similar substances that accumulate in the air layer, forming a "blanket". Substances that act in this regard are freons, methane, ethane, nitrogen oxides, hydrogen, water etc.

The properties of these substances are such that ultraviolet rays give possibility to pass easily. Reaching the surface of the land these rays are transformed into heat, and heat from the ground surface passes back through this layer much harder, so it creates the situation that, "as the quilt is thicker even as it is hot" [7].

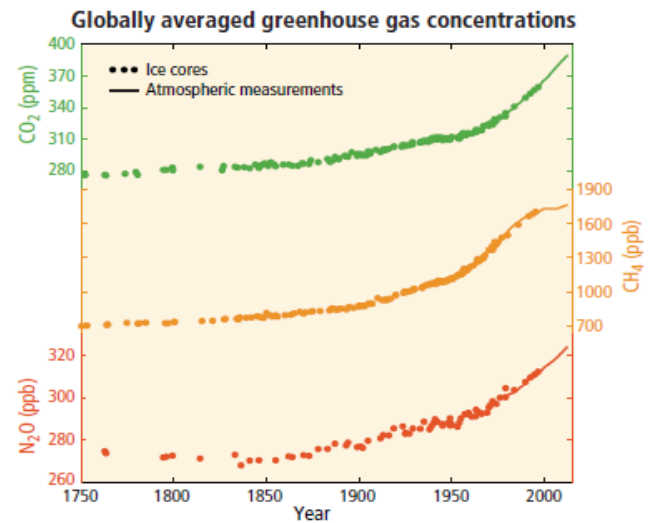
Kyoto Protocol [10] addresses the problem of emissions of six greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF<sub>6</sub>).

According to a 2007 study [26], 22% of global emissions of greenhouse gases come from agriculture, a similar percentage in the industrial sector, but higher than in transport. Cattle, especially transport and feeding them, are at the origin of 80% of emissions of greenhouse emissions from agriculture. Emissions of greenhouse grew faster between 2000-2010 than in the preceding three decades, and nearly half of

the carbon dioxide emissions in the period 1750 - 2010 is due to last 40 years. 2014 IPCC Report Mitigation of Climate Change states that 62% of emissions of greenhouse gases between 2000 - 2010 effect are represented by carbon dioxide. The elimination of these gases by natural processes is much slower than their production. Thus, they will remain longer in the atmosphere, leading to increased natural greenhouse effect. For example, the lifetime of carbon dioxide ( $\text{CO}_2$ ) in the atmosphere between 50...200 years, methane ( $\text{CH}_4$ ) is 12 years and nitrous oxide ( $\text{N}_2\text{O}$ ) 114 years [17].

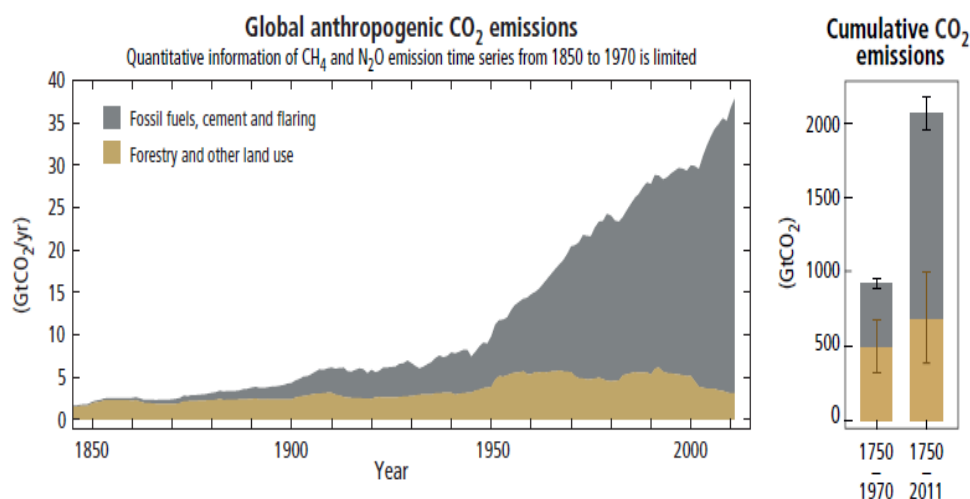
It is estimated that about 35% of total emissions of greenhouse gases released into the atmosphere worldwide, results from the production and distribution of energy. Of the total amount of energy produced in the world, 80% yield based on the combustion of fossil fuels. Extracting these fuels produce  $\text{CO}_2$  and  $\text{CH}_4$ , and their combustion  $\text{CO}_2$  and  $\text{N}_2\text{O}$ . In combustion processes, the carbon content of fossil fuels are oxidised and released to the atmosphere as  $\text{CO}_2$ . Intensifying greenhouse effect does not have the same consequences on the entire surface of the Earth.

Polar regions will be more affected than the equatorial and coastal longer than the inner surface of the continents .



**Fig. 1.** Variation of  $\text{CO}_2$  concentration,  $\text{NH}_4$  and  $\text{N}_2\text{O}$  into the atmosphere [19]

Figure 1 shows the evolution of the atmospheric concentration of carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ) and nitrous oxide ( $\text{N}_2\text{O}$ ) assessed on the basis of information provided by layers of ice (dotted) and direct measurement [19].

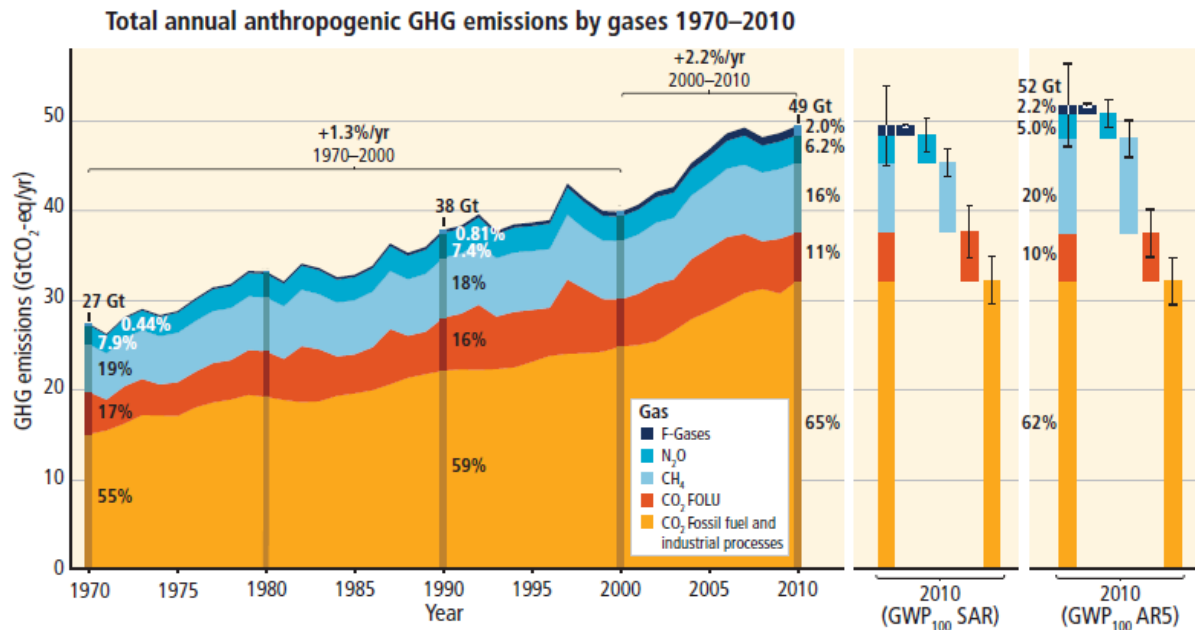


**Fig. 2.** Global  $\text{CO}_2$  emission, the equivalent gigatons [19]

Emissions of greenhouse grew faster between 2000-2010 than in the preceding three decades, and nearly half of the carbon dioxide emissions in the period 1750-2010 is due to last 40 years (Fig. 2).

They come mainly from burning fossil fuels, cement and other combustion and the release to the forests, animals and vegetation zone [FOLU].



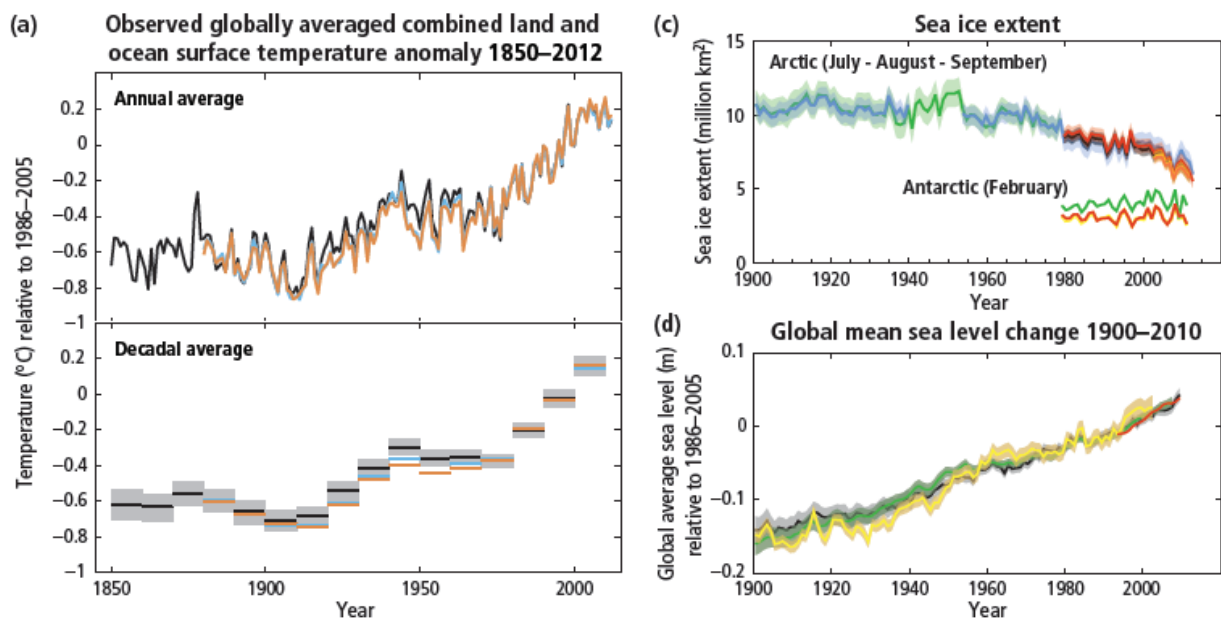


**Fig. 3.** Total annual greenhouse gas emissions effect in gigatonnes of CO<sub>2</sub> equivalent / year [19]

Figure 3 shows the extent to which participate in forming the total amount of greenhouse gases different sources and how they have evolved individual and overall GHG [19].

Warming of the climate system is unequivocal, experts say IPCC, and monitored developments after 1950 has no precedents in the latter part of

the last millennium. It is considered that during the 30 years between 1983 to 2012 there has been a warming climate more pronounced than in the past 800 years or even than in the past 1,400 years (Figure 4 a and b) [22].



**Fig. 4.** The average annual temperature variation (a) and decadal (b) of the Arctic ice cap (c) and oceanic water level (d) by 1850 [22]

Experts Intergovernmental Panel on Climate Evolution (IPCC) launched an alarming diagnosis of the dangers of global warming,

meaning that a warming of the Earth 2-3° C above the average temperature in 1990 would have a huge negative impact on all regions of the

planet [5]. By 2080 about 3.4 billion people will suffer from serious shortages of water caused by melting glaciers, while another 600 million people will suffer from hunger from drought, soil degradation and soil salinization. Drought affecting large parts of southern Africa, Latin America, the Mediterranean, Middle East and North Africa.

Excessive heat or fever abnormal specific global warming process, even some risks to public health, especially in urban areas, where temperatures are higher. It confirmed that high temperatures increase the risk of death in people sensitive to the effects of heat stress. The greatest vulnerability presents people aged over 65 years (retired). Also, the heat can cause real disasters, promoting or maintaining forest fires produce human negligence.

The main effect of global warming is represented, however, the drought, which has a devastating impact on food production and hence human health. More serious is that the drought is proving a phenomenon with greater frequency and areas more extensive in countries emerging with large populations where such diseases as pellagra, iron deficiency anemia, hypocalcemia, hipomagnezia, low content of macro and micronutrients (vitamins, minerals), but also weaken the body's resistance to pathogens have devastating effects. About two billion people in developing countries are anemic dezvoltare, and 1.1 billion people worldwide are malnourished.

Experts believe that to avoid a bleak future of the planet, should the 2050 greenhouse gas emissions to fall by twice world and four times in industrialized countries. The optimistic scenario assumes that by 2100 the average global temperature will increase by 1.1-2.9°C.

Specialists with great reluctance regarding such a scenario, especially due to the inertia in ecological systems and huge quantities of CO<sub>2</sub> into the atmosphere collected in the last hundred years [16].

In summary, in presents a variation slightly alarmist five main negative effects of global warming process: rising sea levels and ocean; hurricanes and intensifying storms; drought and desertification; ocean acidification; danger of total extinction.

## 2. Current aspects regarding urbanization and its correlation with global warming

The fundamental feature of world population in the post war period is considerable acceleration in the growth rate, whose value reached 2% annually. This process has been called plastic explosive demographic. The world's population has increased in the last two decades with 1,146,000,000 inhabitants, or around 46%. Asia contributed to this increase by 700 million, representing 60% of the total, while Europe, North America and Oceania, with just under 140 million, representing 12%. Over the same period the population of Africa grew by 58%, America 56%, Europe 18%, Asia 52%, with 52% of Oceania and Russia 35%. As a consequence, the growth rates in the period 1963-1970 a big fan know: 0.6% annually for the population of northern Europe and 3.4% for the population of Central America.

Following the evolution of the population in Romania, it can show that it follows the European trend as seen in Table 1 [27].

**Table 1.** *The evolution of the Romanian population, by year [27]*

Period	Total world, mil /year	Developed regions, mil /year	Developing regions, mil /year	Total world, %	Developed regions, %	Developing regions, %
1960-1970	65	11	54	2.0	1.1	2.4
1750-1800	4	1	3	0.4	0.4	0.4
1800-1850	6	2	4	0.5	0.7	0.5
1850-1900	8	5	3	0.5	1	0.3
1900-1950	17	6	11	0.8	0.8	0.8
1950-2000	80	12	68	1.9	1.1	2.3

On the other hand, the UN estimated that 7.2 billion people living today, as the global population will grow to 8.1 billion by 2025, most of the increase taking place in developing countries, particularly in Africa [8]. According to UN experts, by 2050 the world population will

number 9.6 billion people, and 2100 are expected to live on Earth nearly 11 billion people. The study reveals that around 2028 India's population will exceed that of China's number, when both countries will have about 1.45 billion people.

Urbanisation is defined as a "process of transformation of social and professional Structure, a restructuring of forms of rural life and the old urban forms after new models" [4]. Also, by means urbanization and urban population growth over time relative to the population of rural areas. In principle, the urban area is the area where they held activities unrelated to agriculture. In most countries and cities have privileged legal status associated with specific administrative forms.

Urbanization is regarded as a factor of social progress, in most situations this offering superior materials socio-rural areas. However, in terms of influence on the process of global warming, urbanization accelerated in the last three decades and included the negative factors. Urbanization is now a trend accelerated growth as it brings a host of facilities to conduct more comfortable life through better access and quality of population to public services (systems of water supply, sewerage, sewage treatment waste management systems, etc.).

The city, however, is a specific ecosystem, a complex of natural and artificial factors that provide a range of facilities to conduct more comfortable life, but that exposes the population to various risks and discomforts, depending on the organization and use thereof. Most often in urban systems, artificial factors extend the natural detrimentul. Urbanization rate refers to the percentage annual increase in population in urban areas of the country, being inversely proportional to urbanization normal (eg. Africa, South America, Southeast Asia). China alone is expected to move from rural to urban areas in the next 20 years 350 million. Also in this country during the period 25...30 cities will exceed 20 million inhabitants each, with unpredictable consequences for the climate and all aspects of the natural environment in those areas.

The implications of the urban population growth are multiple, standing out mainly [24]:

- pressure on urban sectors (housing, infrastructure, economy, environment, education, health) due to serve the needs of the rapidly growing population;
- increasing urban non balanced in the sense that there is a growing urban excess in one area of a country and the emergence megaoraşelor (eg Banngkok is 30 times larger than the second largest city in Thailand and Lima include about 1/3 of Peru's population). Megacities are specific to developing countries, but are also found in developed areas of the world. The most populous

city in 2015 was Tokyo, capital of Japan, with 36.5 million inhabitants, the figure is relative, because the city's population increases every year at least 0.5 million. A similar growth rate is also reflected in Hong Kong, while in mainland China and South East Asia growth rates and large urban areas are higher;

- Economic growth is directly proportional to the increase rate of urbanization, with the exception of most states in Africa and some South Asian.

Today, however, the huge increase in urban population occurs in developing countries, particularly in Asia region (over 55%), which largely determines the character of the contemporary world urbanization less controlled.

One of the obvious characteristics of modern urbanization is rapid growth in the number of megacities (over 8 million) and their population concentration. In the mid twentieth century 7th each country have a city with over 1 million inhabitants, and currently has about 375 Earth agglomerations with population over 1 million, where there are about 37.6% of city dwellers and 17 8% of the world [23].

Compared to the many blessings of urbanization should not overlook its negative effect on environmental degradation and global warming. Concrete and glass have replaced huge green areas, highways annually swallow million hectares of farmland and smog sometimes force people to wear masks to filter respirators. It notes that forced and chaotic urbanization have also caused damage to the environment that are huge expenses for their removal or even impossible for the current generation.

Specialists of global warming have already set changes that will move the planet in the next hundred years. These changes will be felt most in crowded urban areas. Will feel a lack of natural RESOURCES, a decrease of water resources, food, health will be put to hardships, there will be many cases of respiratory, allergy, cardiovascular and gastrointestinal diseases.

The greenhouse effect is manifested more intensely in large urban areas, where buildings with many floors are not only permanent sources of greenhouse gas emissions pronounced, but also additional sources of heat coming from the huge energetic consumption, concentrated in volumes arranged vertical, which provides the connection to the ground is no longer any heat exchange. Total alienation of the individual lost in an urban multi-million exposes it to numerous



mental illness, with negative consequences on yield intellectually and even physically.

Urbanization is regarded as a factor of social progress, in most situations this offering superior materials socio-rural areas. However, in terms of influence on the process of global warming, urbanization accelerated in the last three decades negative factors included the negative factors.

### **3. The concept of "green city" and its relationship with urbanization and global warming**

The concept of green city is increasingly circulated in the context of increased greenhouse effect and pollution continued growth over the planet. In a green city can be found features that make urban life healthier, more pleasant and friendly surrounding ecosystems.

Urbanization less controlled achieved in recent decades, especially in countries developing, but also in Eastern Europe and the developing region of the world, made often by infringement of the urban core, such as on the provision of water and green areas, capable of reducing the negative effects that they cause environmental conurbations. All organizations worldwide, continental, regional or state adopted recommendations, guidelines or laws allowing city dwellers to enjoy decent living conditions, in terms of the environment.

In Romania, the Constitution stipulates in Article 35 "right of everyone to a healthy and ecologically balanced environment." In this context, Law no. 24/2007 [9], regulating and managing green spaces in urban areas states that "The State recognizes the right of every individual to a healthy environment, free access green spaces for recreation in public ownership, the right to contribute to the Lawns at creating alignments of trees and shrubs, in compliance with legal provisions "(art. 6). In the same law, urban green areas are defined as a network mosaic or a system of ecosystems semi, whose characteristics is determined by vegetation (wood, tree, shrub and flower and herbaceous) and includes parks, squares, planted alignments or free land, unproductive plot (art. 6) .

The most important are parks, thanks surface and facilities available, and functions that include. Prin this law "governing the management of green spaces, public interest objectives, to ensure the quality factors environment and health of the population" (art. 1).

In the 319 urban settlements in Romania, where 55.2% of the population lives, due to the trend of permanent expansion of built space, especially in the last two decades has seen, most often, a reduction of green spaces [21]. Thus, if the years 1980-1990 in Romania urban green areas increased from 169.62 to 220.81 km<sup>2</sup> respectively 30%, after it registered a downward trend until 2006, when it produced a slightly riviriment reaching 202,69 km<sup>2</sup>. Because of this situation, it was that the average area of urban green space in Romania is today only 18 m<sup>2</sup>/capita, while in Europe it is frequently 25 m<sup>2</sup>/capita. Given that Rule the World Health Organization is 50 m<sup>2</sup>/capita and EU standards are 26 m<sup>2</sup>/capita, that the population of cities in Romania lacks in many cases, the minimum required for spares (Bucharest has only an average area of 9.67 m<sup>2</sup>/capita). Some studies show that the main value of green spaces derives from their ability to restore the "wellbeing" of persons attending them. They provide the urban population quiet places to relax and reduce stress, to escape from the built environment and traffic. The green areas are responsible, therefore, mainly human needs for recreation and leisure.

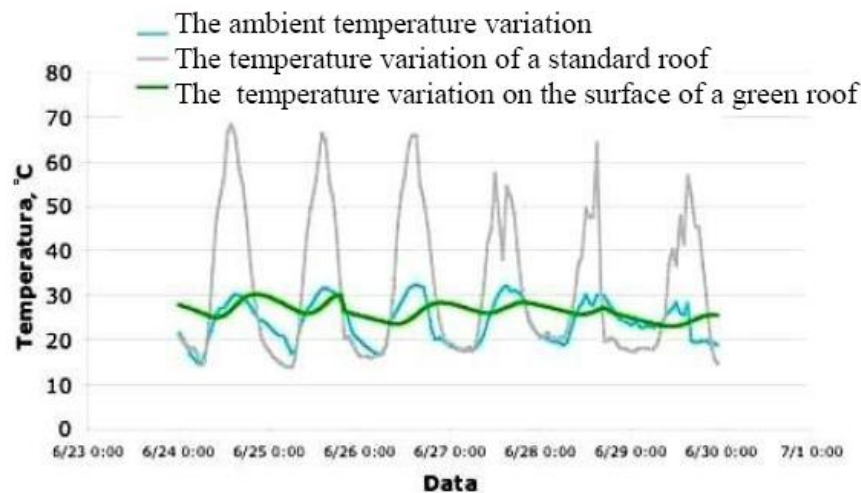
No urban population can not ignore endlessly that their cities can be found many places within city limits, different sizes, abandoned (the dispute or the property is not known whom), often acting as a repository for junk. European initiatives, north American, Japanese, etc. on "greening" cities are diverse and interesting . Some cities, such as Philadelphia-USA have already declared "green cities", thereby trying to mobilize a growing number of citizens in activities for the benefit of the whole community .

An important component of the concept of "green city" refers to the cultivation of plants on the roofs and balconies of buildings in major cities to improve air quality and to give a more human aspect of these cities [11]. Among the concerns that arouses a growing interest is the creation of green roofs or buildings that can be grown not only pitch, but also flowers, vegetables or bushes, developing true even organic greenhouses [3]. By growing flowers or vegetables on the roofs and terraces of buildings nature plays a part of the area that was deprived by the construction of these buildings, complement and highlight their architecture and large urban areas gives a little friendlier. A suggestive name for buildings "green" is that of "vertical farm" (vertical farm) [1, 2].

In fact, this aspect are dedicated a lot of research and achievements, which will become apparent hereinafter.

Due to the major advantages of green roofs brought to the residents of urban centers and beyond, people are becoming increasingly interested in their presence in everyday life.

According to research conducted by Penn State Center for Green Roof Research of Pennsylvania State University in USA, the advantages of a ecological mounting roof are obvious, as can be seen in Figure 5.



**Fig. 5.** Variation in surface temperature of a roof standard, compared with that of a green roof [18]

Due to the emergence of a multitude of high-performing materials, there is the possibility of creating cultures directly into the soil surface disposed on the roof allocated. Figure 6 shows an example of planning for cultivation of small rooftop St. Luke's International Hospital in Akashi, Tokyo (Photo: Ian Muttou on Flickr) [18].



**Fig. 6.** The ecological roof St. Luke's International Hospital, Akashi, Japan [18]

It should also be chosen plants whose dynamics to match such a project to be viable long time and that can be easily replaced with like.

Travellers can admire the green roof of the airport in Amsterdam (Netherlands), where

landscape architects have managed to create a useful and pleasant ambient environment (Fig. 7) [13].



**Fig. 7.** Green roof of the airport in Amsterdam [13]

It follows from the results that the establishment of a green roof (ecological) has a number of advantages, among which we can mention:

- retain rainwater as it prevents water run-off by 75%;
- reducing consumption energetic in space under roof, both during winter and summer, acting as a thermal insulator true;

- waterproofing protection from ultraviolet radiation, and freeze-thaw cycles, thus extending the life;

- improving air quality in urban areas, because the plants filter the air and absorb carbon dioxide;

- using green roofs in urban agriculture projects can create a local food system for the community;

- aesthetic improvements and obtain spaces with recreational destinations etc.

Note that achieving a green roof is a very complex action. As remarked Mary Ann Uhlmann in Chapter 5 of [14], such a project should attend: botanists; horticulturists specializing in the environment (for plant selection and maintenance), APLI of horticulture and horticultural academic research; agronomists knowledge of interactions between plants and soil and of agricultural technologies; specialists in soil science; geologists; environmentalists; landscape architects; engineers specialized in civil engineering, thermal and hydro insulation, irrigation and climate control etc.

Green roofs can reduce heating costs or air conditioning in homes with up to 26%, ensuring optimum thermal insulation for the entire year, according to studies conducted by the manufacturer of additives and building materials Sika Romania. Another advantage of this type of roofing is the ability of plants making up the atmosphere to absorb pollution and to prevent excessive emissions of greenhouse gases. At present, the degree of promotion and implementation of green roofs is growing worldwide. Currently, in Germany, 10% of all roofs are environmentally friendly and in Switzerland legislative rules require that any newly built covering an area greater than 500 m<sup>2</sup> to be achieved using such a system [12].

However, in temperate zones are truly green roofs 6-8 months a year, the rest of the time their effects are much reduced. An improvement of this situation is the location of protected areas on roofs, where plants can be grown throughout the year.

Until recently considered a utopia, the idea of setting up greenhouses on the roofs of apartment buildings, businesses and institutions of all kinds, catch more ground, this arrangement is not only an oasis of tranquility, but also a way that can reduce pollution, noise, dust and the amount of carbon dioxide in the atmosphere etc. Economic aspect should not be neglected that can offer such emissions.

One of the largest global producers of greenhouses Nexus Corporation is the North American company. It produces more than 10 years, among other things, to be located on the roof greenhouses (Fig. 9) [20].



**Fig. 9.** *Types of greenhouses produced by Nexus Corporation USA [20]*

One such project, shown in Figure 10, was conducted for Florida State University.



**Fig. 10.** *Greenhouses located on the roof of Florida State University [20]*

Following requests were also placed greenhouses and other buildings such as Arkansas State University, University of California, Centralia Community College etc.

The material used for the resistance structure is extruded aluminum and the coating of acrylic glass was used. Growing plants in greenhouses is preponderant developed in hydroponic system.

Figure 11 shows the culture established in a greenhouse roof at Gotham Greens, Greenpoint, New York, USA.





**Fig. 11.** Greenhouses constructed on the roof of Gotham Greens, Greenpoint, New York, USA. [27]

Examples of greenhouses located on the roofs of buildings are numerous, they are constantly multiplying, both in Europe and the US.

## Conclusions

1. The main cause of global warming is regarded as increasing the concentration of  $\text{CO}_2$ ,  $\text{NH}_4$  and  $\text{N}_2\text{O}$  in the atmosphere in recent centuries.  $\text{CO}_2$  concentration was 280 ppm (parts-per-million), before the industrial revolution, is now 400 ppm, which is nearly double, and 2035 could be 550 ppm, if the flow actual emissions of greenhouse emissions (GHG) would be maintained beyond the natural capacity of absorption. In this scenario in the immediate aftermath average temperature increase would be higher by  $2^\circ\text{C}$ . The main factor underpinning the global warming process is considered the greenhouse effect, which manifests itself more strongly in the earth's atmosphere.

2. The greenhouse effect causes global climate change, but also has positive consequences in the sense that the absence of such substances that the average temperature on Earth to be about  $-15^\circ\text{C}$ . In the last 50 years about 95% of ambient temperature has risen due to increased emissions of greenhouse gases (water vapor, which cause the greenhouse effect on Earth at a rate of 36...70%, except clouds dioxide carbon in the amount of 9-26% methane, 4-9% ozone in a proportion of 3.7%).

3. An important contribution to accelerating global warming has explzivă world population growth and urbanization out of control in some areas, of which require increasing energy consumption, helping to accelerate the growth rate of greenhouse gas greenhouse, namely global warming .. the fundamental feature of world

population in the postwar period is considerable acceleration in the growth rate, whose value reached 2% annually. This process has been called plastic explosive demographic.

4. One of the obvious characteristics of modern urbanization is rapid growth in the number of megacities (over 8 million) and their population concentration. In the mid twentieth century 7th each country have a city with over 1 million inhabitants, and currently has about 375 Earth agglomerations with population over 1 million, where there are about 37.6% of city dwellers and 17 8% of the world population. The process of formation of cities in developing countries' position is strengthened continuously. In 1975 there were three cities: Mexico City, New York and Tokyo. Today there are 21. For the first time in history the urban population surpassed the rural one. If things go the same way, in 2050 70% of the world population will live in a metropolis.

5. Compared to the many blessings of urbanization should not overlook its negative effect on environmental degradation and global warming. Concrete and glass have replaced huge green areas, highways annually swallow million hectares of farmland and smog sometimes force people to wear masks to filter respirators. It notes that forced and chaotic urbanization have also caused damage to the environment that are huge expenses for their removal or even impossible for the current generation.

6. The concept of green city is increasingly circulated in the context of increased greenhouse effect and the continuous increase of pollution on the planet. In a green city can be found features that make urban life healthier, more pleasant and friendly surrounding ecosystems. Green cities widely used renewable energies, hosting companies using clean technologies, promotes sustainable living and rules adopted both environmental and innovative strategies to promote new environmental concerns.

7. An important component of the concept of "green city" refers to the cultivation of plants on the roofs and balconies of buildings in major cities to improve air quality and to give a more human aspect of these cities. Among the concerns that arouses a growing interest is the creation of green roofs or buildings that can be grown not only pitch, but also flowers, vegetables or bushes, developing true even organic greenhouses.

8. Ecological roofs reduce heating costs or air conditioning in homes with up to 26%, ensuring

optimum thermal insulation for the entire year. Another advantage of this type of roofing is the ability of plants making up the atmosphere to absorb pollution and to prevent excessive emissions of greenhouse gases. Currently, the degree of promotion and implementation of green roofs is growing worldwide.

9. The main drawback is the green roofs in temperate zones, limiting the period of plant vegetation at 6...8 months a year. By comparison, in greenhouses located on the roof vegetation plant is maintained to normal throughout the calendar year.

10. Currently, the idea of location of greenhouses on the roofs of apartment buildings, industrial facilities and public buildings is so successful as firms in the construction of greenhouses devoted to classical and other new companies have focused some of its activity on the design and implementation of this type of greenhouses. Perhaps this is the main reason why most of the greenhouses on the roofs are very similar to those on the ground.

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# CURRENT STATE OF USE OF JERUSALEM ARTICHOKE AS A FUNCTIONAL INGREDIENT IN THE PRODUCTION OF FUNCTIONAL FOOD PRODUCTS

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**Abstract:** The paper presents first conceptual functional food and a classification of the main categories of functional foods. Next, it is presented the importance of Jerusalem artichokes in human nutrition prin compozitia chimica. Jerusalem artichoke contains, besides other valuable minerals, an impressive amount of organic (natural) silicon, up to 8%, of the dry matter. After current research, silicon is part of the group of elements necessary for normal growth and development of animal and human organism, being considered an indispensable mineral. It is necessary for the synthesis of collagen - protein from connective tissue. Silicon enters the elastin composition of the blood vessels, and when the silicon content in the body is low, there is a decrease in the elasticity of the artery walls and increase in their permeability. The inulin content of the Jerusalem artichokes is up to 80% of the dry matter.

In the context of economic and social progress, human health is becoming an increasingly important personal and social value. Because of the costs associated with curative medicine, prevention of emerging health problems is very important. That is why we need a new orientation in the study of the relationship between man and food.

According to a working definition adopted in a European Consensus document in 1999:

A food may be considered as "functional" if it is satisfactorily demonstrated to beneficially affect one or more target functions in the body, beyond the appropriate nutritional effects, in a manner that is relevant to a good state of Health and well-being and / or reducing the risk of disease. The degree of knowledge of a functional ingredient influences the perception and acceptance of functional foods by consumers. In this sense, functional foods can be interpreted as the carrier of functional ingredients with certain health benefits. Existing studies suggest that products containing certain functional ingredients will be more successful on the market if the consumer is aware of the ingredients inherent in a healthy life.

**Keywords:** fortified food, conventional healthy food, dietary fiber;

## 1. Outlining the concept of functional food

Although legislation regulates health and nutrition claims used to promote functional foods, there are still different opinions in this area [13]. Specifically, specialists and authorities have not reached a consensus on their definition. The concept of functional foods involves reforming the nutritional composition of foods to meet the physiological needs of consumers. Intervention on the composition of conventional foods is done in three directions [3, 13]:

- enriching content in .... (For example, foods rich in dietary fiber, or fortified foods with calcium or magnesium);
- decreasing content in ... .. (eg foods with low salt or saturated fat content);
- replacing the component ... with (for example, sugar is replaced by low glycemic sweeteners such as inulin). Foods falling within one of these directions have been scientifically evaluated and may be accompanied by references to their specific beneficial effects on health. A definition of work was adopted in 1999 in a European Consensus:

• *a food can be considered a "functional food" if it is satisfactorily demonstrated that it affects one or more of the target organisms in the body beneath the appropriate nutritional effects in a way that is good health and well-being and / or reducing the risk of disease. Functional foods must remain food and must show their effects in the amounts that can normally be expected to be consumed in the diet: these are not pills or capsules, but they are part of a regular food product* " [4].

Currently, other terms are used in this context, without mutually excluding them, such as:

- *fortified food* - conventional food, which is enriched with a nutrient that is beneficial to health (European Commission, 2010);

- *nutraceutical product* - synonymous with functional food (Nutraceutical Institute, UK);

- *reformulated food* - a conventional food whose composition has been modified to reduce the sugar, saturated or trans fat or salt content for a healthy diet. In some contexts, reformulation may include fortification (European Commission, 2005);

- *food product rich in nutrients* - any conventional product whose consumption is recommended in a healthy diet (eg. cereals, fruits, vegetables) without necessarily having scientific evidence on these recommendations. If there is scientific evidence, such products may contain nutrition claims (eg. fiber rich, sources of vitamin K); (European Commission, 2010);

- *conventional healthy food* - a nutritionally modified conventional product (eg. low-fat, non-fat), which contributes to a healthy diet [22];

The definition of the functional food formulated in the FUFOSE project (1998) is considered to be the most complete and appropriate for the subject of this thesis, namely:

*"A functional food is defined as that food if it is scientifically demonstrated that it generates health benefits in general or specific to a health problem through its nutritional content as part of a healthy diet without being medicated or supplemented."*

In conclusion, functional foods should be considered as foods that are attractive to consumers by means of health and nutrition claims, provided that these claims are scientifically proven in accordance with the legislation in force. Other terms of interest for the topic addressed are defined, in accordance with Regulation (EC) No. 1924/2006 on nutrition and health claims associated with food, as follows:

*"nutrient"* means the proteins, carbohydrates, fats, fibers, sodium, vitamins and minerals listed in the Annex to Directive 90/496 / EEC and substances belonging to one of the categories concerned or are compounds of one of the categories concerned;

*"mention"* means any message or representation that is binding on us under community or national legislation, including representation in the form of images, graphical or symbolic representation, of whatever form, which asserts, suggests or implies that a food has great features;

*"nutrition claim"* means any requirement that suggests, affirms or implies that the food has special beneficial nutritional properties due to:

- the calorific value it delivers, supplies it to a high or low level or does not supply it; and / or

- the nutrients or other substances it contains, contains them to a high or low degree, or does not contain them;

*"health claim"* means any claim that states, suggests or implies that there is a relationship between a category of food, a food or one of its constituents and health;

*"reference to reducing the risk of disease"* means any health claim that states, suggests or implies that a risk factor in the development of a human disease is significantly reduced by the consumption of a food category, a food product or one of the constituents thereof;

*"other substance"* means a substance other than a nutrient that has a nutritional or physiological effect.

In view of the above, the following conclusions can be drawn:

According to the Japanese Ministry of Health and Social Protection, functional foods are expected to have certain health benefits, and have been allowed to wear a label claiming that a person using them for a specified health use can expect an improvement in health through their consumption. This category includes:

- foods that are expected to have a particular health effect due to relevant constituents or foods from which allergens have been removed;

- foods that have a plus or removal effect that have been scientifically evaluated and allowed to make claims about their specific beneficial effects on health.

In this overall context, the EC organized a concerted action involving a large number of the most prominent European nutrition and related scientists employed by the EU - to study functional food sciences [11].



"Target function" refers to genomic, biochemical, physiological, psychological, behavioral functions or which are relevant to maintaining a well-being and health or reducing the risk of disease. Modulation of these functions should be assessed quantitatively / objectively by measuring biochemical markers (eg. metabolite, specific proteins, hormones, enzymes, etc.) or physiological parameters (eg measuring blood pressure, heart rate, gastro-intestinal transit time measurement, etc.) or changes in physical and intellectual performance with objective parameters.

## 2. Classification of functional foods

A distinctive feature of FoSHU is that commercially available FoSHU products include a wide variety of common foods, such as

beverages, yoghurt, rice, noodles, bread, cereals, biscuits, margarine, cooking oil, mayonnaise, sausage and fish paste which can be incorporated into daily meals. Following the introduction of the FNFC into the FHC system in 2001, FoSHU was classified in 2005 in four groups: "Standardized FoSHU", "FoSHU with Reduction of Risk of Illness", "FoSHU Qualified", and "Frequent FoSHU" [10]. For example, undigested dextrins and certain oligosaccharides are recognized as functional ingredients that promote bowel health and are already used in many FoSHU products. In such a case, foods containing these ingredients at suitable concentrations may be homologated as FoSHU standardized because they are considered to have sufficient scientific evidence to support claims.

**Table 1. FHC Classification 2005 [10]**

Medicine	Food with Health Claims (FHC)					So-called healthy foods	Common foods
	Foods with functional nutrition claims (FNFC)	Foods with specific health use (FoSHU)					
		Common	Standardized	Foods with reduced illness risk	Qualified		

The 2005 FoSHU review also allowed manufacturers to apply for few foods with less scientific evidence for the FoSHU system. Foods that do not have sufficient scientific evidence can be approved as FoSHU qualified if they have a certain efficacy. FoSHU with the indication of disease risk reduction were introduced by MHLW, with the agreement of the Codex Committee under the aegis of the World Health Organization / Food and Agriculture Organization. The first EU funded project between 1994 and 1998 was the FUFOSE project (*Functional Food Science in Europe*) (ILSI, 1998). The impact of this project has been beneficial both for food research activities and for the functional food industry, which since then has been steadily increasing, although the European Food Safety Authority (EFSA) legislation is relatively strict on the approval of foods with nutrition and health claims.

## 3. The importance of Jerusalem artichokes in human nutrition

Jerusalem artichoke (*Helianthus tuberosus* L.) is a perennial plant of the Asteraceae family, originating in North America. Man used this plant for more than 2,000 years BC, and in the first millennium before Christ the spice went into Indian farming. In Europe, the plant was brought by French sailors in the seventeenth century. Due to the similarity with the sunflower, which was also brought to Europe in North America, the Jerusalem artichokes are known in Italy as "artichokes" or "sun artichokes".

In Russia the Jerusalem artichokes was brought from China, but not as a vegetable, but as a medicinal plant under the name of "Chinese Potatoes".

**Table 2. Composition of Jerusalem artichoke tubers [8]**

Analyzed part	Dry substance	% dry matter				
		Protein	Fat	Extracted unsolved substances	Ash	Cellulose
Airpart	18,00	10,00	1,80	55,80	14,50	18,10
Tubers	119,20	11,40	1,00	78,00	5,80	4,20

In Romania the name of this vegetable is "nap". Over the past two decades, a renewed interest for

Jerusalem artichokes has begun and its introduction into various agro-climatic areas.

This increased interest in Jerusalem artichokes is related to the emergence of new aspects of its use, apart from the food industry, namely in biotechnology and therapeutic area. Jerusalem artichoke has a rich composition of biologically active substances (Table 2).

Jerusalem artichoke has a high mineral content [2, 19, 20] and a high inulin content [14]. This plant exceeds, from the point of view of the mineral content, many of the frequently consumed vegetables (potato, carrot and beet) (Table 3).

**Table 3. Mineral content of Jerusalem artichokes [8]**

Mineral elements	mg/100g dry matter						
	Fe	Mg	Ca	Mn	K	Na	Si
Content	10,10	44,00	78,80	31,70	1382,50	17,20	8000

As shown in Table 3, Jerusalem artichoke contains, besides other valuable minerals, an impressive amount of organic (natural) silicon, up to 8%, of the dry matter. After current research, silicon is part of the group of elements necessary for normal growth and development of animal and human organism, being considered an indispensable mineral [8]. It is necessary for the synthesis of collagen - protein from connective tissue. Silicon enters the elastin composition of the blood vessels, and when the silicon content in the body is low, there is a decrease in the elasticity of the artery walls and increase in their permeability [8]. The inulin content of the Jerusalem artichokes is up to 80% of the dry matter [8]. As source of inulin, Jerusalem artichoke has the following effects: laxative, collagogue, diuretic, spermatogenic, stomach and tonic effects, its tubercles being used in traditional medicine in diabetes and treatment of rheumatism. Inulin is a natural polysaccharide that contains 95% fructose. This belongs to the carbohydrate class called fructans. Inulin is composed of fructose units having a terminal glucose molecule, being a non-reducing polyglucid. The amount of inulin from the Jerusalem artichoke depends on the species, the plant maintenance and the climate [16].

In recent years, independent researchers conducted by various research teams have shown that its chemical composition, rather than the high content of inulin, has a beneficial influence on the gastrointestinal system [15] have developed a method of extracting inulin from the Jerusalem artichoke (*Helianthus tuberosus* L.). Samples of inulin extracted in an aqueous medium without the addition of organic solvents were fermented with prebiotic bacteria *Lactobacillus paracasei*. In parallel, commercial inulin samples obtained from chicory (*Cichorium intybus*) were fermented. From the data obtained from these investigations it can be concluded that fermented inulin samples obtained from Jerusalem artichoke had very good in vitro prebiotic activity, even higher than the commercial inulin samples obtained from chicory. This indicates that inulin obtained from Jerusalem artichoke may be considered a possible prebiotic ingredient. Its valuable composition in biologically active substances of Jerusalem artichoke makes this plant a promising prospect for the food industry, in dietetic nutrition and as a raw material for the preparation of dietary supplements.

**Table 4. The Jerusalem artichoke production between 1961-2011 (tons) Source: FAOSTAT/2015**

Țara/Continental	1961	1970	1980	1990	2000	2011
Italia	416.900	670.800	597.700	487.000	512.946	474.550
Asia	10.600	15.966	11.945	33.438	80.504	149.339
Europa	692.809	1.060.147	1.032.894	1.045.612	899.845	747.501
EU	696.409	1.065.227	1.036.739	1.048.512	902.965	750.054
Franța	160.000	125.820	102.544	97.118	63.605	50.589
Grecia	24.000	43.127	44.450	33.594	31.000	38.000
Israel	1.300	6.400	1.450	5.763	4.905	2.419
Argentina	18.000	67.600	58.800	72.000	74.075	100.891
SUA	23.133	30.436	42.664	50.547	45.900	45.314
Mexic	0	0	80	546	2.988	3.193
Mondial	855.442	1.276.057	1.254.405	1.333.471	1.317.527	1.541.383

#### 4. Consumption of products with Jerusalem artichoke intake

For three thousand years, man has known Jerusalem artichoke and since ancient times has been attracted to the unique power of the plant that allows him to survive in the extreme conditions of the environment and to produce large crops compared to other tuber plants.

From the data presented in table 4 it is noticed

that in Europe, the US and worldwide, with only a few exceptions, the peak of the production was in 1990. In Romania, the production of Jerusalem artichoke reported, started in 1999.

In Romania, the production of Jerusalem artichoke, according to FAOSTAT data, has been reported since 1999, with a peak of 2,474 tonnes in 2004, after that it fell to 589 tonnes in 2011 (Tabel 5).

**Table 5.** *The Jerusalem artichoke production in Romania Source:FAOSTAT/2015*

România	1999	2004	2006	2007	2009	2011
Tone	1.500	2.474	2.200	1.656	1.446	589

Jerusalem artichoke comes from America and is widely grown in temperate areas. However, the cultivation of this plant is not in line with its potential [9]. Jerusalem artichoke is grown mainly for its edible tubers, which vary in size and shape. Some tubers are similar to potatoes, small, round and knotty, while others are long, large and smooth [18]. These are consumed raw, cooked or as potatoes. They were consumed as basic food or emergency food in Western Europe during the Second World War, and are currently very known and consumed vegetables [9]. Jerusalem artichoke is also used as animal feed.

Jerusalem artichoke falls into the category of commercial energy crops because it is a plant that is suitable for high density crops with high production yield and can be successfully used as biomass for fuel or for obtaining ethyl alcohol [5].

In Romania, at the Buzau Vegetable Research and Development Resort, researchers have set up an experimental Jerusalem artichoke lot and research is being carried out to develop a technology for obtaining Jerusalem artichoke liquid sugar. At a canning factory in Romania, Jerusalem artichoke is used as a raw material for obtaining a sweet, organic product, namely the jam of Jerusalem artichoke. In the manufacture of food supplements only S.C. Hofigal Export Import S.A. uses Jerusalem artichoke as raw material.

As can be seen in table 5, in Romania the Jerusalem artichoke culture is not developed to the potential of this plant. Due to the large stems, which in some varieties exceed 3 meters in height, this plant can also be successfully used to create protection curtains to protect crops more sensitive to cold winds, or to prevent evaporation

of soil moisture. Stems can also be used to produce pellets for thermal plants.

Recent analysis of literature has revealed a massive interest in bakery products enriched with functional ingredients; Technological improvements have been made to develop more such products [1].

Thus, it has been studied the addition of several ingredients to improve the nutritional value of wheat flour, such as coconut meal fibers, mango skins, as a source of antioxidants [1, 7], soy proteins [17], potato skin [21], and guar gum [23].

The high content of dietary fiber, especially of inulin, makes Jerusalem artichoke tubers fit, especially for cream soups and purees. Inulin, mixed with water, creates a gel network that gives a smooth and creamy texture [6, 12]. Jerusalem artichoke tubers are commonly used in European restaurants, but their use in the food industry is limited. Tubers have the potential to become a valuable ingredient for food production. New scientific evidence about its functionality in the bakery industry will promote wider use of these tubers [2].

Taking into account these studies, Jerusalem artichoke (*Helianthus tuberosus* L.) could also be used to increase the fiber and dietary minerals content of wheat flour. Only a few studies have been conducted in this area.

#### Conclusions

Recent analysis of literature has revealed a massive interest in bakery products enriched with functional ingredients;

Technological improvements have been made to develop more such products. Jerusalem artichoke (*Helianthus tuberosus* L.) could also be

used to increase the fiber and dietary minerals content of wheat flour.

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# COMPARATIVE STUDIES REGARDING THE USE OF GRAPE SEED POWDER (GSP) IN BAKERY PRODUCTS

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**Abstract:** The paper presents the benefits of grape seed consumption, its properties regarding health and nutrition. The technology and quality control of bakery products with grape seed flour addition is presented in the second part of the paper. The bread quality is defined according to the quality indices that must correspond to the minimum conditions stipulated by STAS. The organoleptic control of all 4 samples is made by appreciating the appearance of the bread, the symmetry of the shape, the volume, the color and structure of the shell, the color, the elasticity and the porosity of the core, the taste, the smell, and the signs of microbial alteration and the presence of the foreign bodies are appreciated.

**Keywords:** grape seed flour, cholesterol, functional food, antioxidants;

## 1. Introduction

Grape seed flour is an extraordinary food. It can substitute a portion of wheat flour from bread, substantially reducing carbohydrate consumption.

It is recommended in vegetarian diets, in fasting or in detoxifying cures, besides being used by athletes, protecting the joints, stimulating anabolism and antidepressant properties.

It helps to protect the heart (can prevent oxidation of LDL or bad cholesterol, this cholesterol can cause hardening of the arteries or even atherosclerosis when it is oxidized).

Due to the flavonoids present in the grapes, it has antioxidant capacity 20 times higher than vitamin E and 50 times higher than vitamin C.

Applied externally, grape seed flour tonifies the skin. It is proposed to make a bakery line at the Hotel Mercur restaurant, from Covasna, which will create new jobs, and bring on the market a new food product of great value [6, 12, 13].

The implementation of the project contributes to the technological development of the bakery industry and to the increased competitiveness of the enterprise.

At the same time, being provided with modern technology will ensure the production of the necessary transportation of the products to the resort hotels and to the cardiology hospital.

Citizens of the city as well as tourists will be more impressed with this innovation because they will have the certainty of healthy food. Functional foods are those foods that treat serious illnesses.

Food is a source of nutrient for the body but also one of the greatest pleasures of life. Moderately consumed foods can be part of a healthy diet provided they are not rich in fats, salt, sugar and calories [4].

Functional foods are those foods that can be consumed in the normal diet and contain biologically active compounds with potential for improving health or reducing the risk of disease. From a practical point of view, functional foods can be:

- Conventional foods containing natural bioactive substances (ex: oat beta-glucan);
- foods that have been modified by enrichment with bioactive substances (ex: margarine with added phytosterol);
- Synthesized food ingredients (ex: special carbohydrates with probiotic effects).

A functional food can be:

- a natural food;
- a food to which a component has been added;
- a food in which a component has been replaced;
- a food whose bioavailability has been modified;
- any combinations of these.

A food product can become functional by using any of the following five ways:

- a. eliminating a component that causes harmful effects when consumed (ex: allergenic proteins);
- b. Increasing the concentration of a natural component present in the food up to a point where it can induce beneficial effects (ex: fortification with a micronutrient to increase daily intake over recommended);
- c. addition of a component which is not normally present in many foods and which is not

necessary a macro- or micronutrient but for whose beneficial effects it has been used (ex: non-vitamin anti-oxidants or prebiotic fructan);

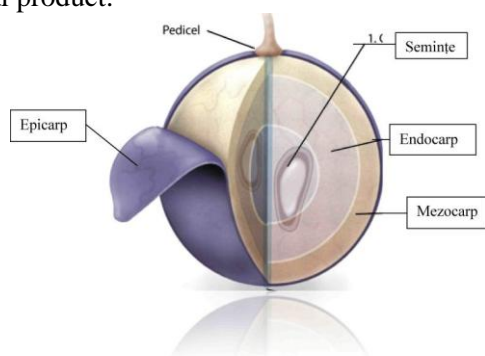
d. replacement of a component, usually macro-nutrient (fatty acids), which is excessive with a component with beneficial effects (modified starch);

e. increasing the bioavailability or stability of a recognized component for its functional effects or reducing the potential risk of disease [7].

The grapes are made up of:

- peel (7-12%),
- core (pulp) (80-92%),
- seeds (2-8%).

The chemical composition of these types of tissue is different and affects the quality of the final product.



**Fig. 1.** Grape seed structure

The peel is the outer shell of the grape, which protects the core and the seeds, while being the headquarters of the coloring and aromatic substances. It consists of 6 to 10 layers of membrane cells with a thickness between 1.5 and 4  $\mu$ . The skin may be thick or thin, elastic or stiff, dense or loose. The outer part of the skin is called cuticle, it represents 1.5% of the weight of the skin and consists of a layer of cells with very thin walls.

The cuticle is coated with a thicker or thinner layer of pruin, which is a waxy substance, composed of palmitic and cerotic acid.

Pulp, also known as core or mesocarp, it is the part of the grain between the skin and the seeds. It comprises several cell layers (20-30) with thin cellulosic membranes. The cell walls represent only 0.5% of the core weight.

The mesocarp cells have the largest dimensions and contain the largest amount of worth, which is also the richest in carbohydrates. The consistency of the grain is different.

The color of the pulp, in most varieties, is golden yellow except for the tincture varieties (Gamay Freaux, Alvarna, black tinctorial) in which the pulp is red. Also, flavor substances in

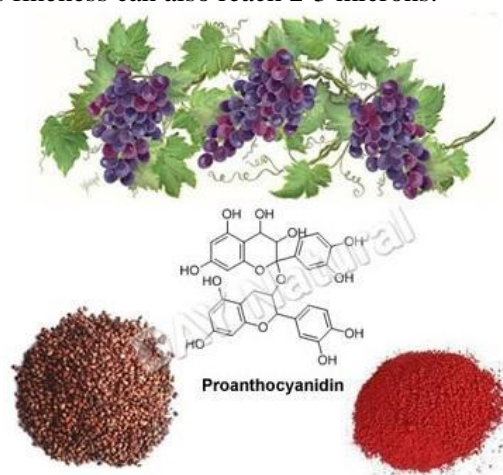
some varieties are also found in the first layers of the core not only in the skin.

Seeds are the most compact parts of the grape composition. They are pyriform and form as a result of the development of fertilized ova. On the outside they have a skin that protects the embryo and the endosperm with back-up substances. In each grain there are up to 4 seeds, but in many grains there are only 1-2-3 seeds.

For this reason, the seed propensity, relative to the weight of the grain, is variable. It is 2-4% in noble varieties, reaching American and direct producer hybrids (HPD) to over 10%. It has been found that there is a certain correlation between the number of seeds, the weight or the size of the grain, the sugar content and the acidity. Grains that have many seeds are larger, accumulate fewer sugars and more acids; Instead, those with fewer seeds are smaller and accumulate higher amounts of sugars [9].

## 2. Composition of grape seed flour

Generally, in grape seed flour, all antioxidants are found in good concentration. The flour is rich in routine, kampferol, quercetin, resveratrol, catechin, epicatechin, antocianidok, P1, P2, B1, B2, B3, vitamins A, C, E and the vitamin B complex [4]. Also contains some minerals such as manganese, potassium, magnesium. Flour powders typically have a size of 10 microns, but its fineness can also reach 2-3 microns.



**Fig. 2.** Composition of grape seed flour

Grape seed flour is pulverized, has a neutral taste, is neither sour nor bitter. The grape seed is found inside the grape, usually in each grain there are up to 4 seeds, but in many grains there are only 1-2-3 seeds, it has a red-brown color.

The smell is similar to the smell of fermented grape in winemaking. They are considered as functional foods because they can be consumed in the normal diet and contain biologically active compounds with potential to improve health or to reduce the risk of disease.



**Fig.3.** *Unmilled grape seeds*

### 3. Benefits of grape seed flour consumption

The earliest records of the benefits of grape seed consumption came in 1936 thanks to Dr. Szentgyörgyi Albert, who also received the Nobel Prize. He was the person who said the grape seed probably contained the most natural antioxidants [9].

American researchers at the University of Kentucky, according to laboratory experiments, have noticed that grape seed extract is prone to the destruction of cancer cells. Within 24 hours, not less than 76% of the cells exposed to the extract were killed, while under the same conditions, healthy cells were not affected in any way [15].

Grape seed flour demonstrated self-destructive activity in cancer cells of the breast, skin, lung, colon, stomach and prostate.

Antioxidant components of flour are polyphenols, which contribute to the inhibition of harmful oxidative processes occurring in the human body.

Harmful materials from our environment, such as contaminated water and air, preservatives, stress or pollen, in the body, lead to the destruction and damage to healthy cells. Grape seed flour is an extraordinary food [15].

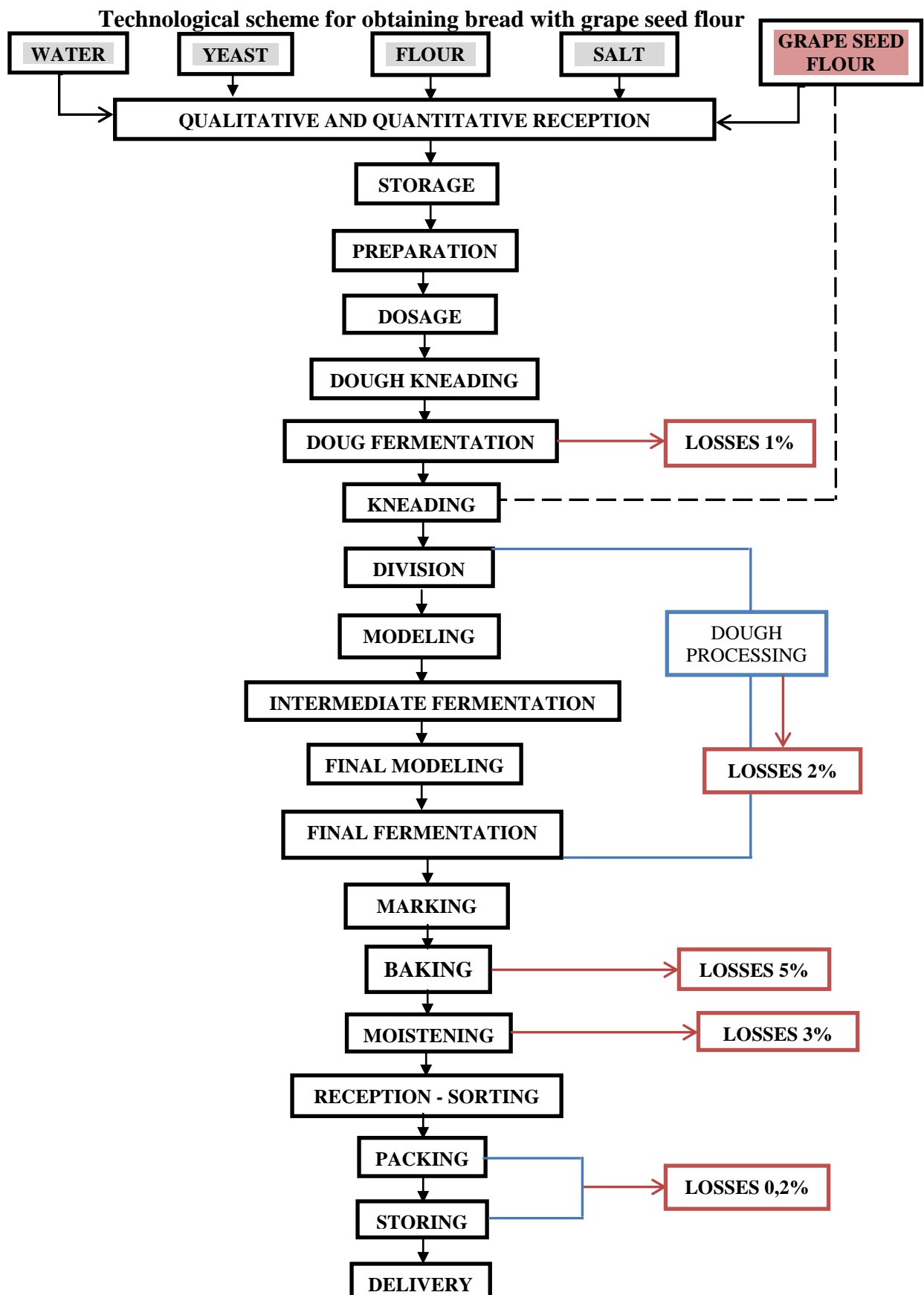
It can substitute a portion of wheat flour from bread, substantially reducing carbohydrate consumption. It has the following benefits:

- They are an excellent source of antioxidants.
  - Protects the body against free radicals.
  - Helps prevent premature aging of tissues, organs and cells.
  - Keep the younger body.
  - Helps prevent stains from aging and wrinkles.
  - Improved circulation.
  - Protects the body against pollution, tobacco and other harmful agents.
  - Cleans the blood from the negative effects of drugs and excessive alcohol consumption.
  - Strengthens the walls of the veins and arteries (due to the flavonoid content).
  - Improve cardiovascular health, being recommended to patients who have had a myocardial infarction.
  - They have anti-inflammatory properties that help treat diseases such as arthritis, gastritis, sinusitis and dermatitis.
  - Cleans the intestines.
  - Maintain optimal vision, skin and brain.
  - Prevent degenerative diseases.
  - Prevent the formation of atheroma plates in the arteries.
  - Fight hair loss and stimulate new hair growth.
  - Maintain healthy and young connective tissues.
  - They have anti-allergic, anti-ulcer and antihistamine properties.
  - Helps prevent cancer.
  - Slow down cataract and glaucoma development.
  - Strengthen the lungs and prevent respiratory failure.
- Strengthen the immune system, preventing many diseases [11].

### 4. Technology and quality control of bakery products with grape seed flour addition

The following diagram shows the possibility of grape seed flour addition in different parts of the technology.

Working mode for bread with wheat flour and grape seed flour (in 5%, 10% and 15% quantities) is shown in table 1.



**Fig. 4.** Technological scheme for obtaining bread with grape seed flour [3]



**Table 1.** *Dough preparation the following recipe [3]*

Raw, auxiliaries materials and technological regime	U.M.	Dough		
		5%	10%	15%
Wheat white flour	g	475	450	425
Grape seed flour	g	25	50	75
Yeast	g	8,5		
Salt	g	6,5		
Sugar	g	7,5		
Water	l	0,25		
<b>Kneading</b>				
Time	min	8-10		
Temperature	°C	29-30		
<b>Fermentation</b>				
Time	min	150		
Kneading I	sec	30(after 60 min)		
KneadingII	sec	30(after 120 min)		
Temperature	°C	30		
<b>Division</b>	pcs	1		
<b>Modeling</b>	-	Toast bread shape (manual)		
<b>Final fermentation</b>				
Time	min	30-40		
Temperature	°C	30-32		
<b>Baking</b>		Oven		
Time	min	25		
Temperature	°C	230		

## 5. Bread quality control

By bread designation is generally meant the product obtained by baking a leavened dough prepared from wheat or rye flour, possibly mixed with other cereals, legumes or potatoes.

Bread and bakery products according to the quality indices must correspond to the minimum conditions stipulated by STAS [5].

**Fig.5.** *Bread with grape seed flour***Table 2.** *Admissibility conditions for the 3 samples of bread with grape seed flour added [3]*

Characteristics		White bread	Bread with 5 % grape seed flour	Bread with 10 % grape seed flour	Bread with 15 % grape seed flour
		Admissibility Conditions			
Aspect	Exterior (general)	Specific format to the assortment, non flattened			
	Crust	Ruddy, golden yellow	Ruddy, light brown	Ruddy, brown to reddish brown	Reddish brown
	Core (in section)	Mass with fine uniform pores	Mass with uniform pores		Not moisty at palpation
		Elastic (after a slight pressure, immediately returns to the original state), without dents or traces of unpeeled flour			
Flavor		Pleasant, characteristic of well baked bread, no foreign smell (mold, rancid etc.)			
Taste		Pleasant, characteristic of well-baked bread, no sour or bitter taste, no scratch due to mineral impurities (earth, sand, etc.)			

## 6. Organoleptic appreciation of bread quality

By the organoleptic way, the appearance of the bread, the symmetry of the shape, the volume, the color and structure of the shell, the color, the elasticity and the porosity of the core, the taste, the smell, and the signs of microbial alteration and the presence of the foreign bodies are appreciated.

### 6.1. Appreciation of exterior bread aspect

The exterior appearance of the bread is controlled by examining the whole bread, following the symmetry and regularity of the shape.

There will be considered the following aspects:

- bread volume: raised, flattened or bulging;
- general appearance of the surface of the crust: smooth, glossy, cracked, burnt, stained;
- color of the crust: normal, corresponding to the bread type, uniform;
- Crust resistance: soft, elastic, hard, brittle.

### 6.2. Appreciation of core aspect

The state and appearance of the core is verified by section examination of the bread. Controls:

- the thickness of the upper and lower crust;
- the overall appearance of the uniform core, if it shows traces or dents of flour or uncooked dough;
- Color of the core: white, yellow, gray, uniform.

The porosity structure is determined by tracking the pore size and uniformity of distribution on the cut surface. It may consist of:

- Small oval-shaped pores evenly distributed over thin walls;
- large or medium sized pores distributed evenly or unevenly with medium or thick walls;
- irregular vacuoles.

Good quality bread has oval, uniformly distributed pores, inclined to about 45 °, with fine walls, no voids or vacuoles. The presence of small, round pores indicates poor porosity. The

mechanical properties of the core are being tracked:

- elasticity: by gently pressing with finger against the surface of the core so as not to destroy the pore structure;

- Resistance to the core when pressed.

If the core resists high finger pressure and deforms slightly, it is compact, dense.

According to the type of return after a slight pressure, the core is classified into:

- Very elastic: returns immediately;
- Elastic: returns slowly;
- Not elastic (insufficiently elastic): does not return to its initial state.

### 6.3. Taste and smell (flavor) appreciation of bread, signs of microbial alteration

In order to verify the flavor, of signs of microbial alteration and presence of foreign bodies, the products are examined as whole, after that are cut and examine the core.

The taste is established by tasteing the crust and the core.

The taste can be normal, pleasant, sweet, slightly sour, sour, unsalty, bitter. The flavor is determined by smelling the core.

Standards provide for the minimum conditions that products have to fulfill in order to be put into consumption.

For a qualitative grading of bakery products in order to stimulate the achievement of a higher quality, a quality assessment method based on a 30-point scheme was introduced. This scheme contains the main qualitative indices of the product that determine its overall quality, combining the organoleptic and physico-chemical examinations.

For each of these indices, a certain score is given. When the product is of superior quality, the maximum score is given, and as the quality decreases, the score is reduced accordingly.

**Table 3. Organoleptic appreciation of bread quality [3]**

Product indices	Scoring scale	Characterization	Score awarded			
			P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>
1. Shape and volume	4	The product has the correct (long), symmetrical, esthetic shape, proving the care it has been worked with, and as volume is well developed, "grown", unpaid or bulging.	4	4	4	-
	2	The product has no fixed shape, it is asymmetric and its	-	-	-	-

		volume is sufficiently developed, it is sufficiently grown.				
	0	The product has no fixed shape, it is deformed, is flattened.	-	-	-	0
<b>2. Color and aspect of the crust</b>	4	The product has a well-rounded crust (from brown to red brown for black bread, from golden brown to light brown for semi-white bread and golden yellow for white bread), the coloration is uniform and appealing, the surface of the crust is smooth, glossy, without cracks or other defects, the crust is crispy.	4	4	4	
	2	The product is unevenly browned, has too dark or pale areas, has a rough, matte surface, or with flour traces, superficial spoilage, or has cracks below 1 cm in width and under 5 cm in length, the crust is not crispy, being a little soft.				
	0	The product has a whitish crust due to insufficient baking, especially at the sides, or has browned parts larger than 1:4 of the surface of the crust, has a wrinkled surface with cracks of 1cm wide and 5cm long.				0
<b>3. The degree of baking. Condition and appearance of the core</b>	6	The product is well baked, so that when bumping into the crust produces a clear, clean sound, characteristic to baked product, has elastic core, pressing the core it immediately returns to the initial state (pressing should be done lightly so that the pore structure is not destroyed) the core has a uniform color, it is dry to the touch, and when cutting the knife blade remains clean, without core adhesions, the core is not broken when it is cut, is smooth.	6	6	6	
	3	The product is baked enough, so that when bumping into the crust produces a muffled sound (not so pure), it has a slightly soft peel; when pressed with the finger, the core returns to the initial state more slowly, cutting it, the knife blade remains clean and the core is not crushed.				3
		The product presents unbaked dough, by pressing the core is irreversibly deformed and easily broken by cutting				
<b>4. Porosity. Core and Pore Structure</b>	6	The product has uniform core porosity and fine pore structure, possibly with a maximum of 2 holes up to 1x1 cm in section, and the determined porosity is: <ul style="list-style-type: none"> <li>- Minim 63% for black bread;</li> <li>- Minim 67% for semi-white bread;</li> <li>- Minim 77% for white bread.</li> </ul>	6	6	6	
	4	The product has uniform core porosity and fine pore (fluffy) structure, but has up to 3 holes of 1x1 cm in section and the determined porosity is within the limits: <ul style="list-style-type: none"> <li>- 60%-62%-for black bread;</li> <li>- 64%-66%-for semi-white bread;</li> <li>- 72%-75%- for white bread.</li> </ul>				4
	2	The product has uneven core porosity, has up to four holes of approx. 2x2 cm in section.				
	0	The product has large section holes and porosity is very low				

<b>5. Flavor (aroma)</b>	<b>4</b>	The product has a pronounced, pleasant aroma (smell), characteristic for well-fermented and well-baked bread	4	4	4	
	2	The product has less pronounced aroma (smell), with no foreign nuances.				2
	0	Is missing or the product has foreign aroma				
<b>6. Taste and acidity</b>	<b>6</b>	The product tastes good (weak sour, sweet), characteristic for the assortment, and the determined acidity is within the limits: - 5,2-5,8 grades for black bread; - 4,4-4,8 grades for semi-white bread; - 2,2-2,8 grades for white bread.	6	6	6	
	4	The product has a satisfactory taste and the determined acidity is within the limits: - 4,8-5,1 or 5,9-7,2 grades for black bread; - 4,0-4,3 or 4,9-5,2 grades for semi-white bread; - 1,8-2,1 or 2,9-3,4 grades for white bread.				4
	0	The product has a pronounced sour, faded or salty taste and the determined acidity is below the minimum or previous limit.				
<b>Total score</b>			30	30	30	13

## Conclusions

Starting from the biological study on grape seeds and the chemical composition of grape seed, different samples of bakery products were made. On them were made comparative organoleptic analyzes between the four samples taken in the discussion.

In conclusion, the optimal addition of grape seed flour is between 5% and 7,5%.

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# IMPORTANCE OF COMBUSTIBLE CHARACTERISTICS OF BIOMASS

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**Abstract:** Research in the field of energy has shown that biomass has a number of combustible characteristics that determine its competitive qualities on the energy market. Biomass reserves differ across the European Union and globally. The forest area ranges from 27,6 million hectares in Sweden to 117 hectares in Cyprus. Worldwide the forest fund occupies approximately 4 billion hectares, with the largest amount being distributed in the territory of the Russian Federation 809 million hectares, Brazil 478 million hectares, Canada 310 million hectares, US 303 million hectares, China 197 million hectares. A particular interest in the use of biomass has been observed since antiquity, when people used wood as the primary source of heating and food preparation, but an essential growth was only observed in the 1990 with the development of modern combustion technologies with superior efficiency. Increasing energy efficiency has a major contribution to achieving security in the field of energy and sustainable energy development, competitiveness in saving primary energy resources and reducing greenhouse energy.

**Keywords:** biomass, calorimeter bomb, value calorific, wood

## 1. Introduction

Biomass, in addition to its main advantages, has a number of disadvantages to fossil fuels.

The biomass density and calorific value of wood species is lower compared to fossil fuels.

Some biomass sources are mostly generated only seasonally, usually during the harvest period, resulting in the need to store and store the material in optimal conditions that will not influence biodegradation.

Thermal systems used for different conversion processes need to have large capacities that will lead to equaling the cost of fossil fuel installations.

Untreated biomass usually has a high moisture content, which is the main factor that causes a low heat content. Thermochemical characteristics and chemical composition of biomass differ largely from fossil fuels.

The physical properties of the biomass are the content of ugliness, density, calorific value, ash content and volatile matter content of the fuel material. The chemical composition of the shall varies depending on the group of wood species (hardwood and coniferous) in the component

parts of trees (branches, stem, roots) depending on geographic position, climate, soil or soil composition.

The ash obtained by burning wood is an alkaline material and contains inorganic constituents. Wood moisture content influences the calorific power of the fuel, combustion temperature and combustion efficiency.

In the first step, wet biomass enter the drying phase, where the water content is evaporated.

From the research carried out, the moisture content of biomass fuel must not exceed 4-10% (wet mass) for pellet, 20% (wet weight) for chips and chips but not exceed 50% for fire wood.

## 2. The energy potential of biomass

The highest inferior calorific value for cereal energy products is obtained for 17070-17370 kJ/kg, which also have a low moisture content of 5,9-6,2%.

Hemp highest have a lower calorific power of 16600-16740 kJ/kg.

The calorific value determined for combustible materials such as, cotton, walnut, pine have values between 15410-19520 kJ/kg.

To determine the calorific power, the Junkers calorimeter, which determines the calorific power for gaseous fuels, was first used. The calorific power of solid and heavy fuels is measured with a calorimetric bomb.

Heat power can be calculated as the difference between enthalpy of combustion products and fuel, if known.

The ignition of the fuel is done by means of the electric current transmitted through the nickel and cotton yarn, and the water inside the calorimeter is mixed by an electromotor stirrer.

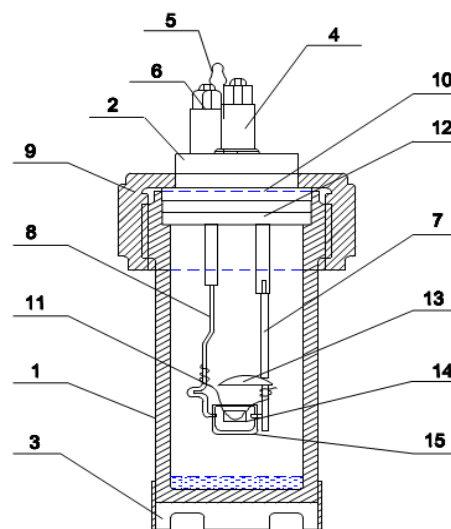
For combustible materials with high water and hydrogen content, such as biomass, two types of calorific power can be distinguished, namely the upper calorific value and the lower calorific value.

The lower calorific power for some combustible materials is hydrogen (141,95 MJ/kg), methane gas (55,6 MJ/kg), dry wood (20,1 MJ/kg). The physical characteristics as well as the chemical composition of the biomass act on the quality of the wood material used as solid fuel. For example contain humidity varying the moisture content between 22-50% relative to the dry mass of the firewood material, or at moisture less than 10% for pellets and briquettes.

### 3. Materials and method

The installation used to determine the calorific value of wood biomass was the XRY-1C explosive type burner produced by Shanghai Changji Geological Institute in China (fig.1). The method of determining the calorific value of wood material refers firstly to the preparation of the raw material, then to the actual determination and ultimately to the final result.

The test sample 1 binds to the cotton yarn 2 and put in the crucible of the bomb 3. Connect the spiral nickel wire 4 to the sample and the cotton yarn, then place the protective cap 5 correctly. The crucible is connected to the calorimetric bomb cap 6 by 2 electrodes 7 and 8, which continues with the electrical coupling bomb of the calorimetric bomb 9 and 10.



**Fig. 1. Calorimeter bomb**

By bombing cap, the bomb 11 is coupled through the stator 12 to the oxygen cylinder, introducing 3 atmospheres.

The test contains three distinct periods (fig.2).

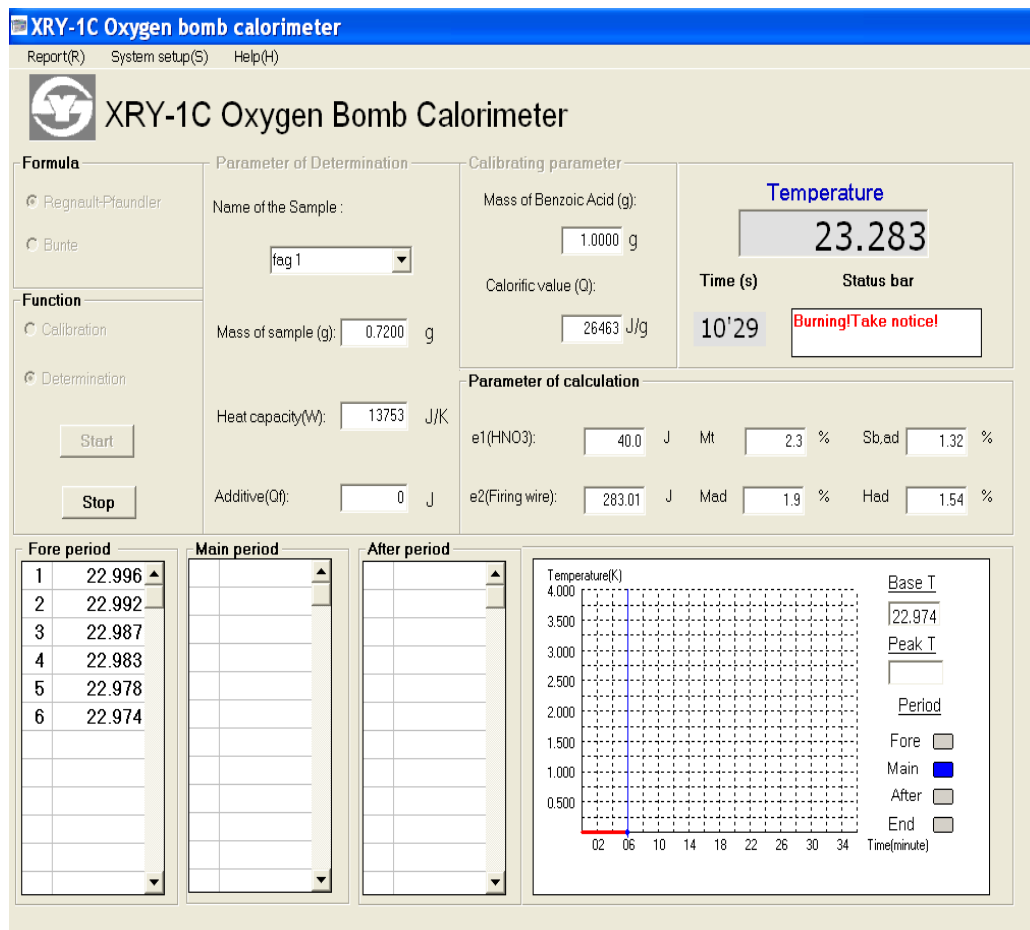
The initial period aims to determine the temperature variations of the water in the calorimetric vessel due to the heat exchange with the outside before the combustion.

The main period starts with the ignition of the sample and consequently increases the temperature of the water in the calorimetric vessel.

The final period aims to determine the average temperature variation of the water in the calorimetric vessel due to heat exchange with the outside.

For spruce,  $m_1 = 0,700$  g,  $U = 0\%$ , gross calorific value is 20051 kJ/kg, net calorific value is 19476 kJ/kg,  $m_2 = 0,9020$  g,  $U = 10\%$ , gross calorific value is 18121 kJ/kg, net calorific value is 17833 kJ/kg,  $m_3 = 0,8803$ ,  $U = 20\%$ , gross calorific value is 16480 kJ/kg, net calorific value is 15904 kJ/kg,  $m_4 = 1,080$  kJ/kg,  $U = 50\%$ , gross calorific value is 11555 kJ/kg, net calorific value is 10115 kJ/kg.

In fig.3 is presented variation calorific value for spruce.

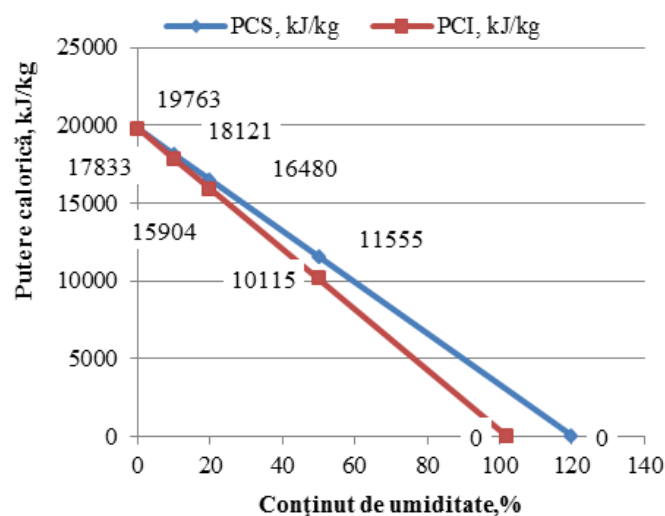


**Fig. 2.** Three distinct period at calorimeter bomb

For spruce,  $m_1 = 0,700$  g,  $U = 0\%$ , gross calorific value is 20051 kJ/kg, net calorific value is 19476 kJ/kg,  $m_2 = 0,9020$  g,  $U = 10\%$ , gross calorific value is 18121 kJ/kg, net calorific value is 17833 kJ/kg,  $m_3 = 0,8803$ ,  $U = 20\%$ , gross calorific value is 16480 kJ/kg, net calorific value

is 15904 kJ/kg,  $m_4 = 1,080$  kJ/kg,  $U=50\%$ , gross calorific value is 11555 kJ/kg, net calorific value is 10115 kJ/kg.

In fig.3 is presented variation valorific value for spruce.



**Fig. 3.** Variation value calorific for spruce

For pine,  $m_1 = 0,8300$  g,  $U = 0\%$ , gross calorific value is 22286 kJ/kg, net calorific value is 21676 kJ/kg,  $m_2 = 0,7700$  g,  $U = 10\%$ , gross calorific value is 19904 kJ/kg, net calorific value is 19660 kJ/kg,  $m_3 = 0,7320$ ,  $U = 20\%$ , gross calorific value is 17828 kJ/kg, net calorific value

is 17340 kJ/kg,  $m_4 = 1,3455$  kJ/kg,  $U=50\%$ , gross calorific value is 11598 kJ/kg, net calorific value is 10378 kJ/kg.

In fig.4 is presented variation valorific value for pine.

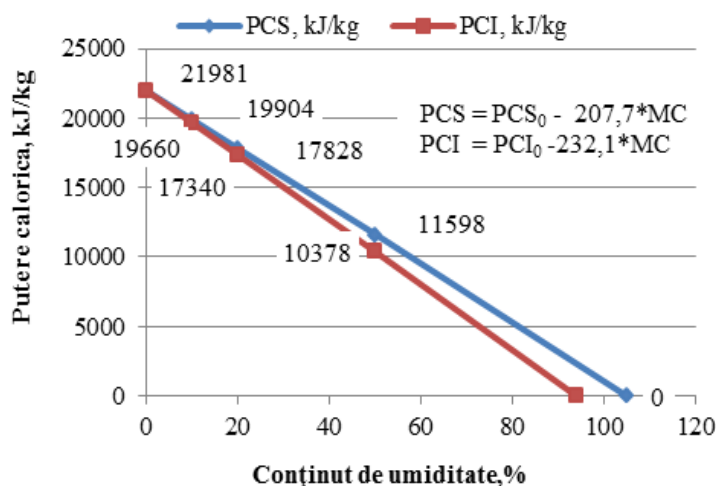


Fig. 4. Variation value calorific for pine

## Conclusions

Combustion is one of the most important thermo-chemical processes of energy production.

Increasing the calorific power of biomass through dry torrefied processes is a current research and investment direction of all the world's states. Current research results in a reduction in biomass leading to increased caloric density.

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# FMEA USED AS RISK ASSESSMENT METHOD IN FOOD LABELING

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**Abstract:** Failure Mode and Effects Analysis (FMEA), is widely used within multiple industries to improve and manage overall quality. The purposes of this method are: the early recognition of failure risks and the reduction of occurrence to a minimum; the avoidance of the possibility of liability claims; the reduction of costs for: for a change caused due to the failures; for additional work (non value added) due to rejects / scrap or rework; for warranty claims in external areas. [1], [2] In this paper we shall use this method for evaluation of the consumer risk information, based on the data acquired during FP7-PEOPLE-2012-IRSES ID: 318946 – NUTRILAB Project. The results shows that the mention regarding “Substances or products causing allergies or intolerances”, “The quantity of certain ingredients or categories of ingredients” and “Special storage conditions and/or conditions of use” are the most important issue for consumer risk. The same method can be extended to other group of products and other risk issues.

**Keywords:** risk assessment, food labeling, FMEA.

## 1. Introduction

Failure modes and effects analysis (FMEA) is a step-by-step approach for identifying all possible failures in a design, a manufacturing or assembly process, or a product or service. “Failure modes” means the ways, or modes, in which something might fail. Failures are any errors or defects, especially ones that affect the customer, and can be potential or actual.

“Effects analysis” refers to studying the consequences of those failures. Failures are prioritized according to how serious their consequences are, how frequently they occur and how easily they can be detected [13, 14].

The purpose of the FMEA is to take actions to eliminate or reduce failures, starting with the highest-priority ones. Failure modes and effects analysis also documents current knowledge and actions about the risks of failures, for use in continuous improvement. FMEA is used during design to prevent failures. Later it's used for control, before and during ongoing operation of the process. Ideally, FMEA begins during the earliest conceptual stages of design and continues throughout the life of the product or service.

Begun in the 1940s by the U.S. military, FMEA was further developed by the aerospace and automotive industries. Several industries

maintain formal FMEA standards. In this paper we shall use this method for evaluation of the consumer risk information, based on the data acquired during FP7-PEOPLE-2012-IRSES ID: 318946 – NUTRILAB Project.

## 2. FMEA as method for risk analysis in food labelling

FMEA will be applied for risk analysis in the area of health and safety and for important projects. In the product development process the design FMEA will be applied before the process FMEA [5]. The most important items are the following:

**Design FMEA** recognizes functional failure modes of the product very early in the design phase, recognize potential safety and environment problems to eliminate doubts and set priorities for design improvement.

Also it helps with the development of a detailed test to check the design and the identification of potential critical inputs and outputs.

**Process FMEA** it is initiated in early in the process improvement investigation after a process map is available; when a new process are being designed; when existing processes are being changed; after process function are defined, but before specific hardware is selected or released to manufacturing.

Update/review of process FMEA it will be made:

### RPN (Risk Priority Number)

The result of a FMEA is the product of three quantitative ratings, in relation to failure effect, cause frequency and detection capability. It is calculated as:

$$\text{RPN} = \text{Importance (severity)} \times \text{Occurrence} \times \text{Detection.}$$

**Severity** (of Effect) is the importance of possible effect on customer requirements - could also concern safety and other risks if a failure occurs (1=Not Severe, 10=Very Severe).

**Occurrence** (of Cause) is the frequency with which a given cause occurs and creates Failure Mode. Can sometimes refer to the frequency of a Failure Mode (1=Not Likely, 10=Very Likely).

**Detection** (capability of Current Controls) is the ability of current control scheme to detect: the causes before creating failure mode and or the failure modes before causing effect (1=Likely to Detect, 10=Not Likely to Detect).

The rating for severity of effect, occurrence and detection will be within the range of 1...10 [15, 9, 6];

The method was applied on the results of the project FP7-PEOPLE-2012-IRSES 318946 – NUTRILAB. This is a multidisciplinary and comparative Joint Exchange Programmed with the mission to identify and examine how nutritional labeling in European countries and out of Europe fulfills the actual legislation requirement.

Fulfilling the nutritional labelling criterions related to European regulation no 432/2012, 1169/2011, 1333/2008, 1924/2006, it is a difficult task, studied by numerous researchers from different locations in the European Union, and the NUTRILAB project was looking forward to the accomplishment of the mentioned criterions in the countries around the Black Sea. In this direction, these regulations were fully studied and identified: Regulation 1924/2006; Regulation 1333/2008; Directive 89/398/EEC of 3 May 1989; Regulation 1169/2011.

After analyzing regulations, a number of information categories were identified that have a very clear specification and can be statistically analyzed [7, 8, 9]. These types of information are:

□ the name of the food product, the list of ingredients,

□ substances or products causing allergies or intolerances,

□ the quantity of certain ingredients or categories of ingredients,

□ the net quantity of the food, (g, ml, kg),

□ the date of minimum durability or the 'use by' date,

□ any special storage conditions and/or conditions of use,

□ the name or business name and address of the food business operator, the country of origin or place of provenance,

□ instructions for use where it would be difficult to make appropriate use of the food in the absence

of such instruction,

□ language, font size, the energy value, per portion or %, kcal and kJ,

□ fat, protein, carbohydrates, saturates, sugars, salt, polys, starch, fibers,

□ MUFA, PUFA, vitamins, minerals, conclusions, recommendations, notes.

### 3. Results

Data obtained during NUTRILAB project were evaluated from consumer risk point of view. From all information categories, the following were considered having a big risk impact:

- substances or products causing allergies or intolerances

- the quantity of certain ingredients or categories of ingredients

- the date of minimum durability or the 'use by' date

- any special storage conditions and/or conditions of use

- language

- font size

A numerical value is then assigned to the severity of the failure (S), the frequency of occurrence (O) and the detectability of the failure (D). These numbers are multiplied to give the RPN. The RPN is an index that gives the relative quality risk associated with each failure mode [2, 4].

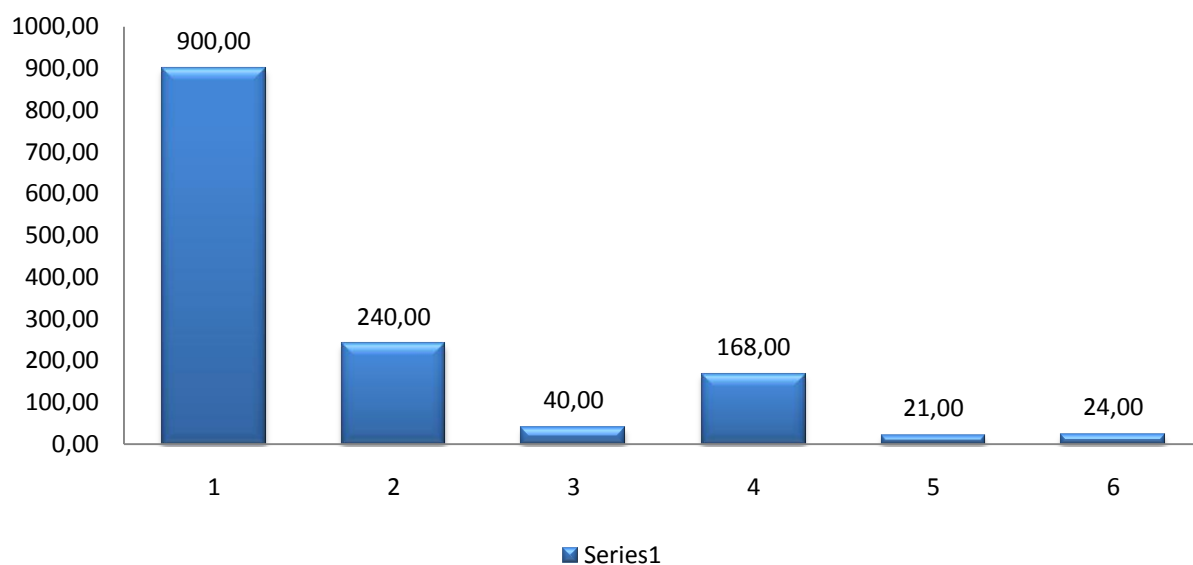
With the FMEA table completed (see table 1, case of sausages), steps in risk issues can be identified by comparing their relative RPNs. The steps with the highest numbers are the biggest risk. A cross-functional team can then decide at what level they will consider an RPN acceptable. A good way to visualize these

relative risks is with a Pareto diagram, the chart created by economist Vilfredo Pareto. This diagram is a simple, easy-to-use method of visually representing which problems are the most vital to quality [1, 10, 15].

A similar analyze was performed for the case of salami and the results are presented in table 2 and figure 2.

**Tabel 1 . FMEA Tabel (study case: sausages)**

Risk Issue	Severity of the failure (S)	Frequency of occurrence (O)	Detectability of the failure (D)	RPN
Substances or products causing allergies or intolerances	10	9,00	10,00	900,00
The quantity of certain ingredients or categories of ingredients	8	3	10	240,00
Date of minimum durability or the 'use by' date	8	1,00	5,00	40,00
Special storage conditions and/or conditions of use	7	3,00	8,00	168,00
Language	7	3,00	1,00	21,00
Font size	8	3,00	1,00	24,00



**Fig. 1. Pareto Diagramm (study case: sausages)**

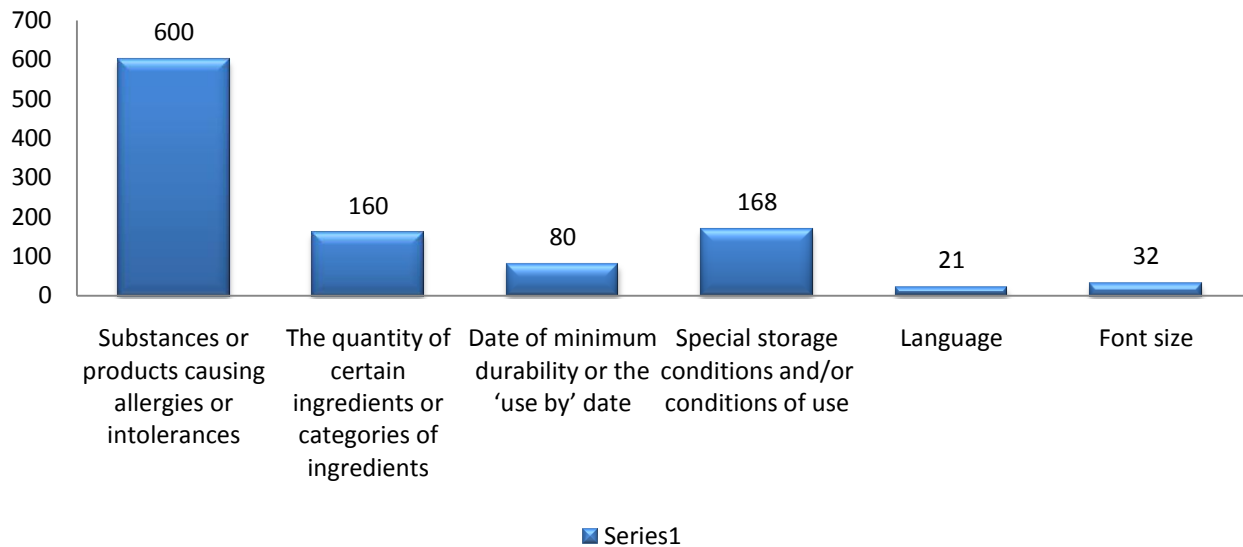
In figure 3 it is presented a comparison between Pareto diagrams for the 2 case products. The values over 100 need special

actions for reducing the risks (S, O or D). In figure 4, there is presented a comparative study of % all criterion fulfilling between different kind of meat product.

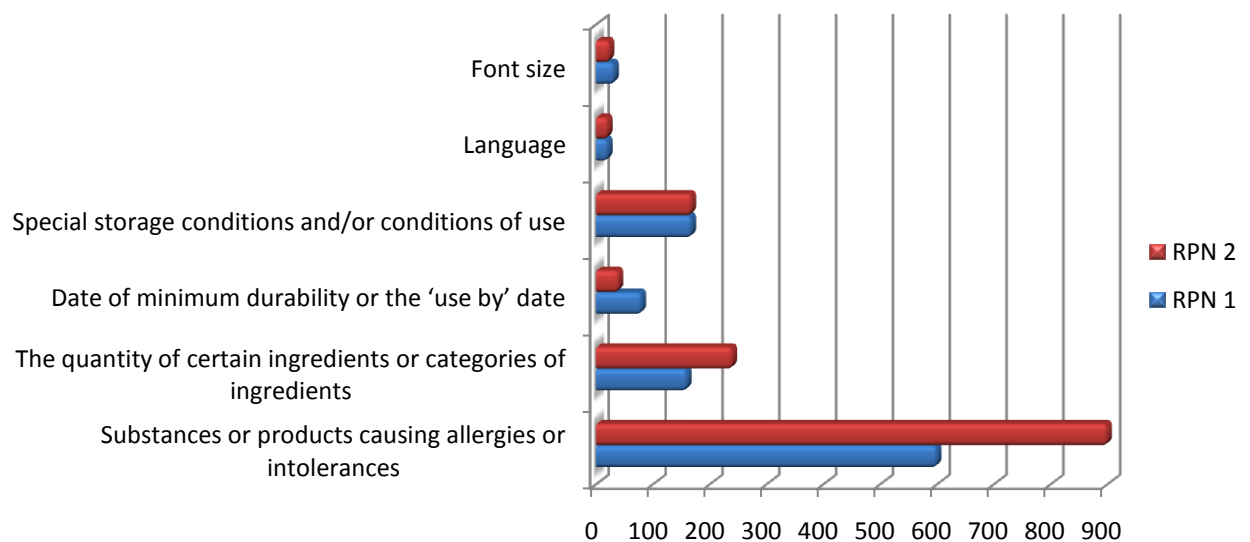
**Tabel 2. FMEA Tabel (study case: salami)**

Risk Issue	Severity of the failure (S)	Frequency of occurrence (O)	Detectability of the failure (D)	RPN
Substances or products causing allergies or intolerances	10	6,00	10,00	600,00
The quantity of certain ingredients or categories of ingredients	8	2	10	160,00

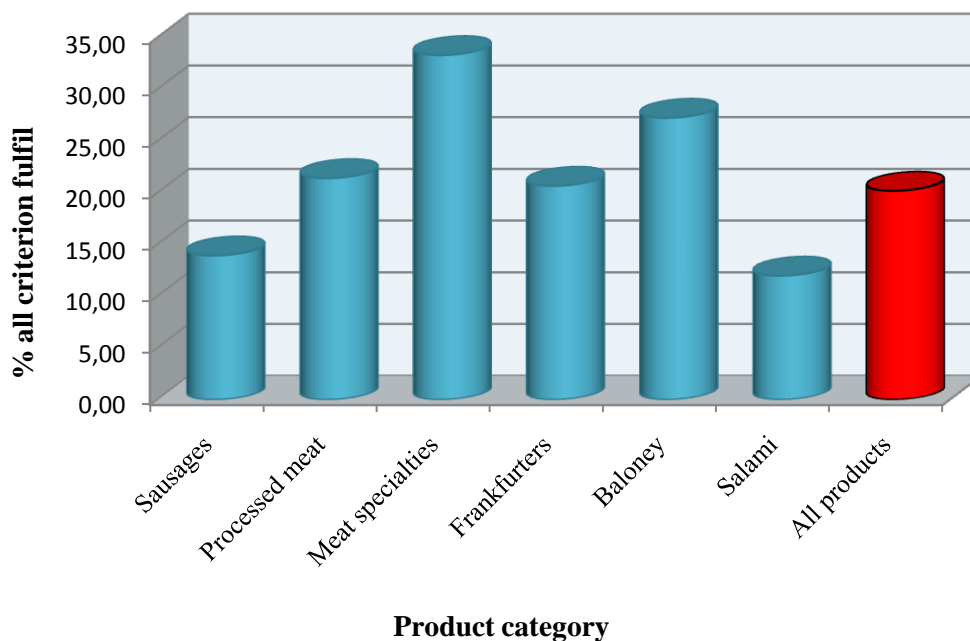
Date of minimum durability or the 'use by' date	8	2,00	5,00	80,00
Special storage conditions and/or conditions of use	7	3,00	8,00	168,00
Language	7	3,00	1,00	21,00
Font size	8	4,00	1,00	32,00



**Fig. 2.** Pareto Diagramm (study case: salami)



**Fig. 3.** Comparative study between Pareto Diagramms (study case: salami vs sausages)



**Fig. 4.** Comparative study of % all criterion fulfilling between different kind of meat product

## Conclusions

The knowledge gained through the FMEA process can then be applied to other products and processes to reduce the risk of consumer. This will build understanding of the CCP methodology, which can be applied to quality risks in the process, allowing the principle of using CCPs to ensure that the safety of the product is continuously under control [3].

The combination of the analysis techniques of FMEA and the control point methodology of HACCP helps create a system where the quality, and safety, of the product is being monitored and ensured by CCPs.

The method can be extended to other group of products and other risk issues.

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# ASPECTS REGARDING ELECTROCHEMICAL DETECTION OF THE ANTIOXIDANT ACTIVITY FOR SUBCRITICAL EXTRACTS FROM PLEUROTUS OSTREATUS

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**Abstract:** The paper presents a comparative study of antioxidant activity of extracts from *Pleurotus Ostreatus*, measured through electrochemical detection by using a biosensor. The extract from *Pleurotus* was obtained by using subcritical extraction with R 134a. Extraction at subcritical pressures of bioactive compounds from plants in soft extraction conditions represents an alternative to replace classical methods of extraction with different solvents, or on enzyme basis. The most important advantage that the HFC extractors with liquefied gas at subcritical pressure offer is that they may extract oils in pure estate, at room temperature and in the absence of air, which allows to create new categories of products with a wide range of bioactive substances.

**Keywords:** antioxidant activity, subcritical extraction, *Pleurotus Ostreatus*.

## 1. Introduction

The genus *Pleurotus* comprises about 40 species and they are commonly referred to as “oyster mushroom”, grow widely in tropical and subtropical areas and easily artificially cultivated. *Pleurotus* genus includes **P. ostreatus**, *P. sajorcaju*, *P. florida*, *P. flabellatus*, *P. highbini* 51, *P. cystidiosus*, *P. sapidus*, *P. eryngii*, *P. tuberegium*, *P. ulmarium*, *P. pulmonarius*, *P. citrinopileatus*, *P. geesteranus* and other some of which are of a special consideration due to their high nutritional values and medicinal importance [1, 3, 7].

Generally, *Pleurotus* mushrooms are rich in vitamin and selenium content which are the important natural antioxidants in biological systems. Some researchers reported that, an extract of *P. Ostreatus* enhanced the Catalase gene expression and decreased the incidence of free radical-induced protein oxidation in aged rats, thereby protecting the occurrence of age-associated disorders that involve free radicals.

The ethanolic extract of the oyster mushroom *P. ostreatus* are reported to have potent antioxidant activity in both in vitro and in vivo. The ethanolic extract exhibit in vitro antioxidant activity by virtue of its scavenging hydroxyl and superoxide radicals, inhibiting lipid peroxidation, reducing power on ferric ions, chelating ferrous ions and quenching 2,3-diazabicyclo[2,2,2]oct-2-

ene (DBO). It also exhibits as a good in-vivo antioxidant activity by reducing the intensity of lipid peroxidation and by enhancing the activities of enzymatic and non-enzymatic antioxidants [12].

The scope of the project is to find the best extraction method for the bioactive compounds, such antioxidants, by using subcritical extraction with HFC 134a. Preliminary results show that the quality and total amount of bio-compounds is higher than classical extraction [8].

Recent researches was done by combining the two methods. In the first stage lipids were extracted on HFC extractor (FC 100, Timatic, Italy), then second phase extracts hydrosoluble compounds in SLE extractor (MiniTimatic, Italy). In this case, extraction efficiency was higher 20-30%-and time was reduced between 32-35 %, also depending on temperature (which was varying between 30-40C degrees). Better results were obtained by applying ultrasound waves in extraction liquid in the second phase.

Various methods for characterization or analytical evaluation of preservatives and antioxidants have been explored and applied.

Alongside chromatographic or spectrophotometric alternatives, electrochemistry of various natural antioxidants is the subject of a active research as is the electrochemical study of the phenolic compounds or their derivatives [6, 9].

## 2. Materials and methods

The raw material studied was *Pleurotus Ostreatus* (fig.1). The mushrooms were procured from a specialized farm in Harman, Brasov County, Romania. After drying 8 hour in a convective dryer at 35degree temperature, the material was milled with a hammer milling machine. Extraction from *Pleurotus* was done

with FC 100 extractor (Timatic, Italy) by using HFC 134a (1,1,1,2-tetrafluroetan) at pressure 5-8 bar and temperature 5-35 C degrees. The extracts were diluted at 3 different concentration: 20, 40, 60  $\mu$ l in pH7 ws.



**Fig. 1.** *Pleurotus Ostreatus*

Antioxidant activity of samples was measured by an electrochemical biosensor, EDEL meter (Edel Therapeutics, Lausanne, Switzerland). The biosensor used in this study was based on the electrochemical measure of potential to determine concentration of analytes or to characterize the chemical reactivity of a compound. Differential Pulse Voltammetry (DPV) has been used for quantification, since it is suitable to measure the redox properties of chemical compounds having low molecular weights. Applying a potential, a redox reaction

occurs on working electrode surface; electrons involved in the reaction modify the current applied in the cell, and this modification is elaborated by a signal transducer. 3 different solution with different concentration of 20, 40, 60  $\mu$ l were used for the experiments.

Each sample, standard solutions or diluted extract samples, was transferred in an aluminium-wrapped becker under magnetic stirring. For each concentration was used a new sensor. 14 experiments were done with the same sensor, for the same concentration.

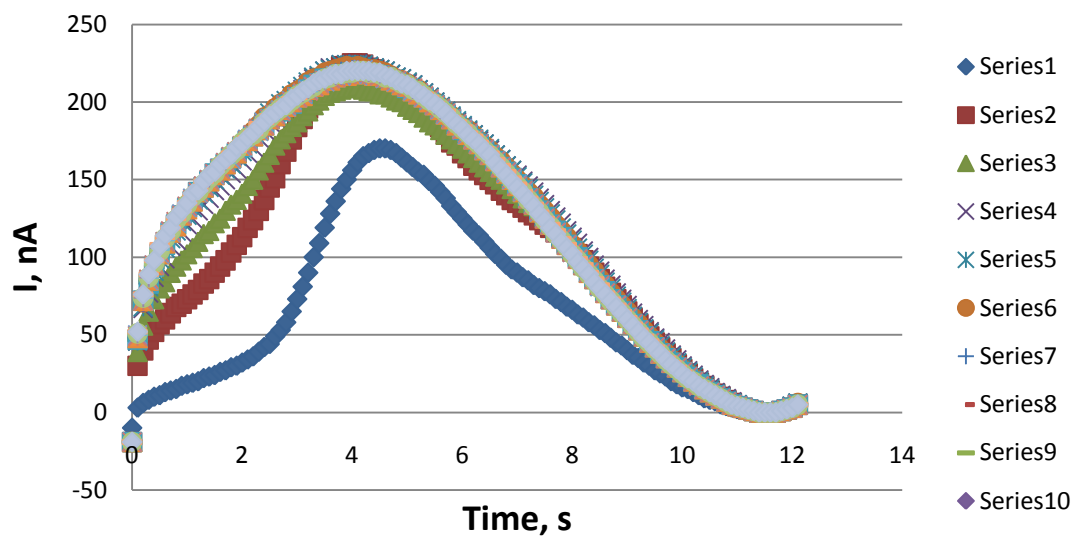
decreasing with the increasing of concentration level (20, 40, 60  $\mu$ l).

The next experiments, done with the same sensors for each concentration, show, for distinct case the saturation of the sensors after imersing in solutions.

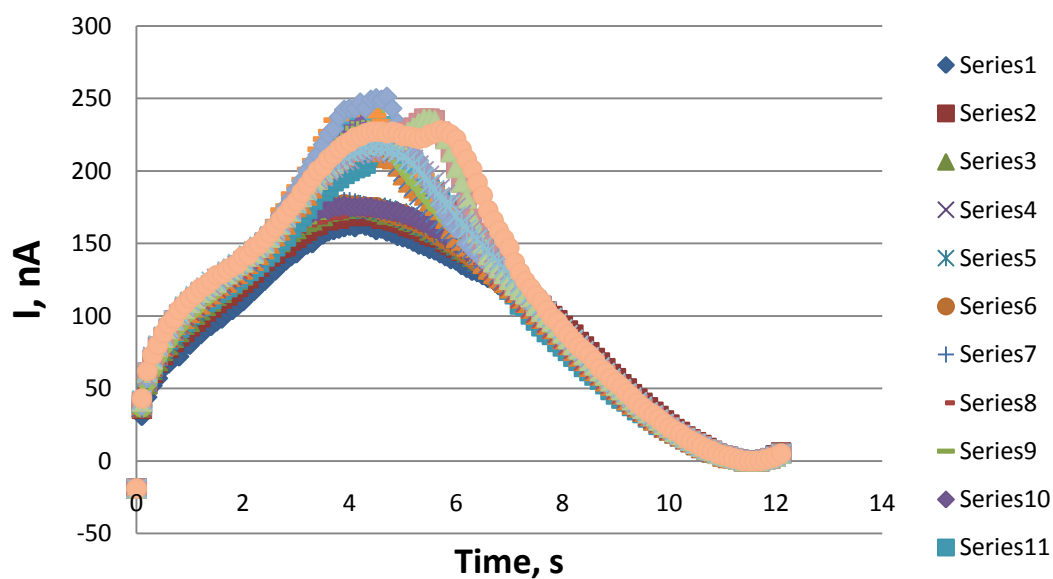
In figure 2, 3, 4 can be observed the comparative results of the antioxidant activity of *Vitis semen*, *Mustard*, *Polygonum Cuspidatum*, evaluated through the intensity of the current between electrodes [nA].

## 3. Results and discussions

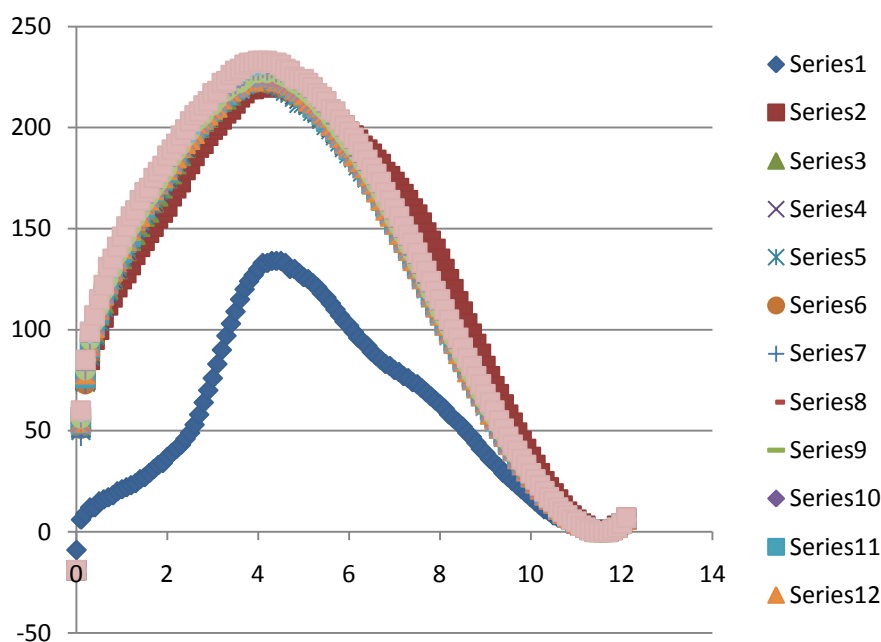
Figures 2, 3, 4 show the class of courves obtained from all 42 experiments. The intensity of the current was recorded during 11 sec, and each time, a maximum value was found between 4 and 6 sec. The first experiment (series1) was done with the sensors unaffected by the extract. It can be seen that the peak value of series 1 is



**Fig. 2** Antioxidant activity of *Pleurotus Ostreatus*, 20 µl concentration, evaluated through intensity of the current between electrodes [nA]



**Fig. 3** Antioxidant activity of *Pleurotus Ostreatus*, 40 µl concentration, evaluated through intensity of the current between electrodes [nA]



**Fig. 4** Antioxidant activity of *Pleurotus Ostreatus*, 60  $\mu$ l concentration, evaluated through intensity of the current between electrodes [nA]

## Conclusions

This paper signified the role of electrochemical method for determination of antioxidant activity in the biological samples of plant origin. Electrochemical techniques represent because its sensitivity, a usefull tool for the determination, under the low concentrations of antioxidants.

The preliminary data obtained with this method showed a high variability in the antioxidant activity of samples, in particular for *Pleurotus ostreatus*.

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