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ALTERNATIVE FIELD CROPS SUCH AS ORGANIC NICHE PRODUCTS REVIEW OF RESEARCH AND DEVELOPMENTAL ACTIVITIES IN SLOVENIA

ALTERNATIVNI POLJSKI USJEVI KAO EKOLOŠKI PROIZVODI PREGLED ISTRAŽIVAČKIH I RAZVOJNIH AKTIVNOSTI U SLOVENIJI

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ABSTRACT

Introduction, production and marketing in alternative (underutilized, neglected, disregarded, rare) crops is a very complex system, but very helpful for producers and consumers. Based on eighteen years of Slovenian experiences since establishment of certification of organic agriculture, research on under-utilized field crops and publisi materials we can conclude that many additional activities are needed to establishing an effective production system and market for underutilized field crops. Primari, high by efficient organic production must follow professional knowledge of production, guidelines for organic production and post harvest technology including food processing. Special attention must be paid to production of introduced species in the region. For example, our research project on four oil crops grown under dry conditions, including greenhouse experiments is a contribution to how to include less sensitive crops into rotation systems because of climate changes. Activities such as expansion of the knowledge on organic products, and especially about nutritional and health value of crops are very important. Organizing projects why and how to use this kind of food in the kindergartens, schools, old people's homes and hospitals shows promising results, especially when the culinary presentation includes explanation of beneficial effects on human health. On the other side the useful research is obligatory; for example an explanation how to prepare tasty and highly essential amino-acid valued bread made from grain amaranth and whole meal spelt. Also the models for decission support are developed, but due to the lack of data, their use is not often in accordance with the needs in practice.

Key words: organic farming, marketing, alternative crops, underutilized crops, knowledge

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SAŽETAK

Uvođenje, proizvodnja i prodaja alternativnih (zapostavljenih) usjeva je vrlo složen, ali i vrlo koristan proces za proizvođača i za potrošača. Na temelju osamnaestogodišnjeg slovenskog iskustva od pokretanja i certificiranja ekološke poljoprivrede, istraživanja malo korištenih poljskih usjeva i publiciranih radova možemo zaključiti da su potrebne još mnoge dodatne aktivnosti kako bi se uspostavio efikasan proizvodni sistem i tržište za nedovoljno korištene poljske usjeve. Visoko učinkovita ekološka proizvodnja treba se temeljiti na stručnom znanju o tehnologiji proizvodnje, stručnim uputama, te tehnologijama spremanja i prerade uroda nakon žetve. Posebnu pažnju traži proizvodni sistem za svaku novouvedenu vrstu usjeva u određenom uzgojnom području. Npr. naš projekt istraživanja uzgoja četiriju uljarica u uvjetima suše, uključujući pokuse u stakleniku, prilog je uključivanju u proizvodnju manje osjetljivih usjeva – vezano uz klimatske promjene. Od posebne je važnosti širenje znanja o ekološkoj proizvodnji, posebno o nutritivnoj i zdravstvenoj vrijednosti takvih proizvoda. Projekti s ciljem uključivanja ekoloških proizvoda u dječje vrtiće, škole, staračke domove i bolnice dali su obećavajuće rezultate, posebno ako su kulinarske prezentacije bile praćene isticanjem pozitivnog učinka na zdravlje. S druge strane neophodna su korisna istraživanja, npr. kako načiniti hranidbeno visokovrijedan (bogat esencijalnim aminokiselinama) i ukusan kruh od štira i cjelovitog brašna krupnika (*T. spelta*). Također, razvijen je model podrške u donošenju odluke, no zbog nedostatka podataka, njegovo korištenje nije u skladu s potrebama u praksi.

Ključne riječi: ekološka poljoprivreda, prodaja, alternativni usjevi, nedovoljno korišteni usjevi, znanje.

Intensive agriculture evidently reduces fields biodiversity including the number of utilized crops and in consequence reduces natural health and nutritional compounds in the food. Underutilized crops are rich natural resources of essential amino acids, antioxidants, minerals, stimulators and other usable compounds, which are often limited to products from just a few main crops produced all over the world. Production of underutilized crops will help to

increase resistance to plant diseases, predators, helping us to produce food without synthetic pesticides (Bavec and Bavec, 2006 c2007). In this case, organic production of underutilized field crops represents a very important option for environmentally acceptable crop production and niche for special 'organic' products. The sale of this kind of products is of special interest to small scale farms because it is a better solution compared to producing and selling cheaper products on global markets. But in this case the consumers, advisers and farmers need professional knowledge about preferences of underutilized crops, production characteristics, clear guidelines for organic production, post harvest technology, food processing including product certification and clear marketing strategies. Also support by educational, research and govermental institutions should be in accordance with these needs. Every specific possibility and activities of each country can influence consumer-producer relationships and effective marketing by specific or/and niche products based on underutilized crops (Williams and Hag, 2002).

INTRODUCTION AND USE OF UNDERUTILIZED FIELD CROPS

Edible underutilized field crops encompass cereals and pseudocereals including millets, pulse crops, root and tuber crops, oil seed crops and dyes, some of which (including fiber crops) are usable for creating new market niches based on small scale production and processing. Furthermore, some of them are also suitable for industrial processing. Depending on country, some of these plants are indigenous, based on spread of secondary diversity and completely new, sometimes exotic. Understanding and use of underutilized crops is based mainly on tradition and their specific growth circumstances. Most of underutilized crops are unknown to a great percentage, especially in the field of food processing (Belton and Taylor, 2002) and use in temperate climate (Bavec and Bavec, 2006 c2007). For example in Slovenia temperate climate dominates, just a small part is mediteranian. For that reason tropic crops should be introduced into temperate climate with special attention to growth period in less than 160 frost days such as for genotypes of sweet corn (*Zea mays* L. var. *saccharata*), batata (*Ipomea batata* L.) and other tropical tuber crops, specific genotypes of grain amaranths (*Amaranthus* sp.), quinoa (*Chenopodium quinoa* L.), groundnut (*Arachis hypogea* L.), vignas (*Vigna* ssp.), etc. The next factor is a system of reproduction based on plant parts growth in greenhouse conditions during winter time like in batata. Spelt (*Triticum aestivum* L. ssp.

spelta MacKey), well adopted to the temperate climate was forgotten and introduced into crop rotations in every organic farm with field crop production during the last decade. Other farro group cereals such as einkorn (*Triticum monocccum* L.), emmer (*Triticum dico*ccum L.), etc. Have been introduced into organic farming just like sample crops on few farms. Buckwheat (*Fagopyrum esculentum* L.), millet (*Panicum milliaceum* L.) and oil seed pumpkins (*Cucurbita pepo* L. Group Pepo) were traditional, but neglected utill the last decade when their production started to increase. The group of alternative oil crops such as false flax (*Camelina sativa* L.), saflower (*Carthamus tinctorius* L.), garden poppy (*Papaver somniferum* L. ssp. *somniferum* Kadereit) are being researched and considered for eventual introduction into crop rotations. We are also looking for some legumes and the group of millets from Africa - potential crops for dry conditions (Bavec and Bavec, 2006 c2007).

Knowledge about food health and nutritional attributes based on underutilized crops is very useful for promotion, decision support for producers and for motivation of consumers for buying products. Special attention needs to be given to antioxidants in food (tokoferols in oil crops, squalen in grain amaranths, anthocyanins in sweet potato, etc.), rich amino acid composition (grain amaranths, quinoa, partly buckwheat, partly legumes, etc.), gluten free foods for people with celiac sickness (buckwheat, grain amaranth, quinoa, millets), quality fiber food (whole grained spelt and other cereals), food rich in minerals, vitamins or their good balance, etc. Many of them are used in pharmacy and alternative medicine, like oil seed pumpkins (Zuhair, et al. 2000), buckwheat (De Francishi et al. 1994; Li and Zhang, 2001; Krkoškova and Mrazova, 2005), amaranths (Rangajaran et al., 1998, Prokopowicz, 2001), etc.

RULES FOR ORGANIC FOOD PRODUCTION

The same standards are used everywhere for certified organic foods where organic farming legislation or standard based on IFOAM or Codex Alimentarius. Organic food contains organically produced ingredients, which is evident from certificates of organic production or processing. There are strict rules for labels and advertising of organic products in many countries.

Food products can be marketed as 'organic' and carry relevant label(s), if a certificate has been issued for them by an authorized control organization. The key rules evident on certificate are as follows:

- That documents about production system are present in accordance with Regulation (EEC) No. 2092/91 (and after 1st January 2009 in accordance with EC No 834/2007). In general organic farming system does not allow the use of synthetic chemicals such as fertilizers, herbicides, fungicides, additives, growth regulators, or gene manipulation of any organism that is a part of food production or processing, in accordance with the principles of health, ecology, fairness and care described by (IFOAM, 2005) 7 and their multifunctionality of sociological environmental impacts.
- The food product or its gradients were not submitted to ionic radiation.
- The food product contains at least 95% of organically produced agricultural or non agricutural origin listed in Annexes (EEC) 2092/91 or further EC 834/2007.
- Processing needs to be strictly under control.

In the new legislation EC 834/2007 special attention and rules will be paid to contamination of organic food with GMOs'.

POTENTIAL CONTRIBUTION OF ORGANIC FARMING TO THE CONSERVATION OF UNDERUTILIZED CROPS AND THEIR UTILIZATION DEVELOPMENT

Traditional cropping systems of undeveloped countries contain numerous genotypes of domesticated crop species, as well as their wild relatives. The richness of plant biodiversity of traditional agroecosystems is comparable with natural systems. It is a reason why underutilized crops have to play a greater role in organic farming. Underutilized crops bring diversity into crop rotations and provide new possibilities for soil cultivation. Organic farming, which is based on traditional farming systems, offers a way of promoting diversity of diet, minimization of risk, reduced insect and disease incidence, efficient use of labour, intensification of production with acceptable resources, maximization of returns (Pažek et al., 2005) and stability under responsible technologies.

Production of underutilized crops helps local communities to be more independent, use the local resources for production and reduce transport expenses. A similar pathway might also be used for organically produced underutilized crops (Dixon et al., 2007). The use of underutilized field crops has resulted in product competitiveness, rich nutritional and health value of food, tradition, locality, special quality according to organic production quidelines and even market attraction. The health and nutritional by rich products, especially if they are produced according to organic farming guidelines, represent a special niche in the market of the developed world. Even non GMO food and food produced without chemicals is becoming very important in human diet.

PRESENT SITUATION AND NEEDS FOR FURTHER RESEARCH

Some crops have been forgotten over time due to economic or religious influences. If the trend continues, it will be a great loss for nations, especially for researchers, farmers and consumers. But nowadays underutilized plants are still very imporrtant in human and animal diet, some also have a special place in medicine. However, in spite of an extensive care for gene banks the erosion of underutilized crops is increasing.

In case of Slovenia there have been many national and international activities in this field, starting with national study programs, international summer schools Alternatives for ecological (organic) field crops production, developmental project CHANNEL and food safety - COMBAT projects, e-learning Ecologica, etc. Also the lack of specific research in some underutilized crops and interactions by production systems, type of soil, photosynthesis, crop protection or even efficient food processing was found (Bavec and Bavec, 2006 c2007). In some cases there is no clear influence of decreasing populations of pollinated insects on yielding.

In Slovenia production systems of few underutilized crops were described (Bavec, 2000) and studied like spelt (Bavec et al. 2006a), buckwheat (Bavec et al., 2002a, Bavec et al., 2006b), oil pumpkins (Bavec et al., 2002b; Rozman et al., 2002; Bavec et al., 2007a), camelina, batata, grain amaranths (Bavec and Grobelnik, 2002; Grobelnik et al., 2004), hemp, garden poppy, flax, etc. The research on food processing and cost effectiveness in six alternative products

has finished. Last year the project on photosynthesis under different soil water regimes in oil crops such as false flax, safflower, oil pumpkins and garden poppy started.

In the framework of a national research project on grain amaranth we also conducted some studies on the use of composite flour containing grain amaranth for bread making purposes (Grobelnik Mlakar et al. 2007a,b; Grobelnik Mlakar et al. 2008a,b). Amaranth flour substitution for cereals in blends for bread making is limited because amaranth seeds, as a pseudo cereal, do not contain gluten (Thompson, 2001), and have a distinct flavour, described as spicy, slightly pungent with bitter aftertaste (Saunders and Becker, 1984). In mentioned studies the influence of basic flour (wheat and spelt of different milling fractions) and amaranth wholemeal flour substitution level (0, 10, 20, 30%) on rheological properties, baking performance and sensory attributes of bread was investigated. All used flours were produced and processed in accordance with the Council Regulation (2092/91) for Organic farming. The number of studies on usage of amaranth containing composite flour is rather limited, and among them there are only some reports on its rheological, baking properties and bread sensory characteristics (Lorenz, 1981; Breene, 1991; Ayo, 2001). However, studies carried out so far have concentrated only on wheat and virtually no research has been reported on composite spelt-amaranth flour.

In the resume of the study, in the part where spelt wholemeal flour as a basic flour was used, we could conclude that maximum viscosity of tested suspensions was not influenced by amaranth addition, initial gelatinisation temperature of suspension was lowered, while maximum gelatinisation temperature gradually increased with amaranth substitution level. Increasing the level of amaranth flour in the blends increased water absorption and farinograph quality number mainly by increased development time and stability of dough. The energy of the dough increased with amaranth flour addition up to 20%, mainly by increasing the resistance to extension and maximum resistance, and decreasing the extensibility. Bread making performance was determined by quality parameters as weight, volume, specific volume of the loaf, and hedonic sensory evaluation (scored from 1-unacceptable to 10-excellent). Considering the results, the incorporation of amaranth into the spelt dough had a positive effect on the colour of the loaf, to a certain extent on the flavour, and on the volume and specific volume at 10% of substitution. Texture, aroma and overall

acceptability of bread were not influenced by amaranth flour replacement. Therefore, according to obtained results, up to 10% of the wholemeal spelt flour in a formulation could be replaced by wholemeal amaranth flour with no detrimental effect on bread quality.

Special attention should be devoted to organic farm management and decision support. The decision support for operating an organic farm is crucial, especially, in the case of long term decisions. Recent applications by Pažek et al. (2006) and Rozman et al. (2006) suggest the use of technologic economic simulation models in combination with multi criteria decision analysis implemented through system DEXi (Bohanec et al., 2000) and analytical hierarchical processes. The presented approach is viable mainly for selection of farm business alternatives in organic farming. The decision making at sector level (policy decision making) on the other hand requires more complex methodologies such as econometric or sector modeling or alternatively system dynamic modeling (Rozman et al., 2007). The ongoing development of organic farming requires even more complex methods of decision analysis and modeling. Future research should be emphasized in the field of organic product marketing and organic product market development.

STRATEGIES FOR MARKETING

Different practices are known for the development of marketing organic products, starting with sales on farm, green markets, and national and international market chains. The next step in case of Slovenia was "Bio-party service" established by the local Association of Organic Farmers. The system of marketing the products is complete food catering with intention to serve special food for banquets, celebrations and other special events. They serve drinks, fruits and different type of dishes based on traditional food and specially underutilized crops.

One of the aims of the project „Healthy food and recreation for health strengthening and protecting" was to araise awareness among people employed in public institutions about the importance of food quality depending on production methods (organic – conventional) for the most sensitive population such as children, patients and elder by people. During the years 2006 and 2007

several seminars were organized for different groups of interested people from kindergartens and schools, public health services, etc.

Although the share of organic products in private households is growing, organic products are often the exception and not the rule in kindergarten or school canteens in Slovenia. Comparison with the situation in several European countries showed, that e. g. in Austria in the region of Styria in some product groups (milk, meat, fruit and vegetables) organic food had reached over 50 percent share in public kitchens which was the result of 5 years project work of the Austrian association of organic farmers (Bavec, 2007b). The change to organic food in France started under the slogan "Eat locally, eat organic" and increase of meals with organic ingredients from 400,000 meals in 2000 to 4.5 million meals was observed in school canteens in 2006. Increasing number of obese and wrongly fed children were the main reasons for implementing a new programme "Food for life" in Great Britain. The aim is to use 50 percent of regional and 30 percent of organic food in 3,600 school canteens. There are some of them using up to 60 percent of organic products. In Italy they serve for kids over 1 million meals a day with organic ingredients (Kreuzer, 2008).

Based on the knowledge that quality of food is dependent on agricultural production methods, a new research project was started in 2007. Differences among organic, integrated and conventional production systems (including genetically manipulated organisms) and their influence on food quality are not investigated sufficiently. The aim of this research project is the evaluation of different agricultural production methods on food quality parameters. Comparison of internal quality parameters of selected vegetable and field crops in different agricultural systems is based on three years of field experiments. Beside yield and yield components investigations are focused on determining internal substances which have health promoting properties: vitamins, minerals and bioactive phenolic secondary metabolites (especially antioxidants) and in sensory evaluation (Bavec, 2007c). Pesticide residues can be found in food although there is an inspection system for food safety and reference values in food have to be obtained. Consumption of organically grown food is often perceived to reduce risk by reducing pesticide residues (Williams and Hammit, 2001). It is not allowed to use synthetical pesticides and light soluble mineral fertilizers in organic production (Bavec and Bavec, 2006 c2007). A recent study of 110 urban and suburban children found measurable levels of organo-

phosphorus pesticide metabolites in the urine of all children sampled, except for one child whose parents reported buying exclusively organic food (Lu et al., 2001). Comparing the traces of on organophosphate metabolite in the urine of preschool children in Seattle (USA) eating organic vs. conventional produce showed 9 times higher DMTP averaged values in children eating a conventional diet (Curl et al., 2003). The knowledge on different risks connected to the food is ever increasing.

Among several goals of an Action Plan for the Development of Organic Farming in Slovenia by 2015, which has been adopted by the Government of the Republic of Slovenia in November 2005, are also:

(i) increasing supply of organic food from local production,

(ii) increasing organic food consumption in public institutions (kindergartens, schools, hospitals, etc.) and

(iii) stimulating short supply chains of organic food (APOF, 2006).

Based on all these facts different activities from the local to the state level are going on. One of them is the initiative of the members of a working group for food and hygiene in Slovene kindergartens to obligatory include organic products in food for children. This demand was submitted to several ministries (for health, education and agriculture, food and fisheries). On the local level they have started to force their food suppliers to include some organic products in to supply, too.

CONCLUSIONS

In case of underutilized field crops we can conclude that considerable multidisciplinary knowledge and activities are needed to understand this kind of potential for established niche markets. Especially the introduction of organic production and processing of underutilized crops into the world-wide developed market is a very complex process with many barriers. The basic rule is that an assessment of production potential and their economic bench-mark is needed. However, an assessment of marketing potential depends on previous interest of producers and consumers for specific niche products. Therefore in this case the main condition and solution we should strive for is targeted education.

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