

Review article

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"LOCAL FOOD - NUTRACEUTICALS": AN EXAMPLE OF A MULTIDISCIPLINARY RESEARCH PROJECT ON LOCAL KNOWLEDGE

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Currently, dietary patterns change rapidly all over the world. Most notably, there is a fast increase in the convenience food market. Here we discuss the overall theoretical framework and strategy of an EU-funded project on local food, a common resource in many parts of the Mediterranean. Such food is often only available seasonally and is consumed either fresh (e.g. spring salads and vegetables, fruits in autumn) or in a conserved form (dried, fermented, pickled). There is an urgent need to document and analyse such local resources, which are today at the brink of disappearance. In this project, selected species were studied using a multidisciplinary approach, including strategies and methods from pharmacology, nutritional sciences and anthropology (i.e. ethnopharmacological or ethnonutritional ones). For example, all extracts were profiled using HPLC-MS, by determining their polyphenol content and using a variety of *in vitro* anti-oxidant assays (incl. guaiacol oxidation, xanthine oxidase inhibition, HOCl scavenging, eNOS activity). Such research also points to ways for ascertaining the intergenerational transmission of the knowledge and for sustainable development and management. Examples from field studies in southern Italy and from pharmacological studies using a variety of targets are used to illustrate the potential of such neglected resources. The wider implications of such an approach, for example, for the study of similar traditions in Central and Eastern Europe are also discussed.

Key words: *Local Food, Mediterranean diet(s), healthy food, traditional knowledge, nutraceuticals, anti-oxidant, ethnobotany.*

INTRODUCTION: Local knowledge and traditional technological knowledge

What is "local knowledge"? Local traditions rely on information being passed on from one generation to the next in one community or in a small region. Food may form a part of local knowledge if its use is confined to a certain area for which it is a characteristic cultural trait. Traditional Food Knowledge (TFK) as part of Traditional Knowledge (TK) is strongly influenced by socio-economic and cultural determinants, religion and history.

The concept of local knowledge has been essential in the field of anthropology. Originally developed in the context of cultural anthropology in the USA, it is now recognised as an important theoretical vision of how to interpret knowledge systems, which often have not been recognised formally. Crucial have been the contributions by Clifford Geertz [esp (1) published in 1983]. His collection of essays "Local Knowledge - Further Essays in Interpretative Anthropology" clearly is a milestone in the discussion about how people interact with each other and their environment. C. Geertz is one of the co-founders of symbolic or interpretative anthropology, which developed in the late 1960's. Culture is - according to Geertz - a complex system of symbols, which allows humans to give meaning to the experiences they face and to communicate these experiences among each other. This culture-specific system of symbols should be recorded as a "thick description", a term he had introduced into the field in 1973 (borrowing it from the British philosopher G. Ryle). It is essential to understand these systems of symbols and to properly describe them in detail. Thus a "thick description" is one based on the experience of a researcher who often comes from a foreign culture, which simultaneously shows meaning systems which have not been visible to the indigenous groups. The symbolic role of "local knowledge" is essential to Geertz's thought and has had a strong impact on anthropological thought.

In first instance it is crucial to point out that "local knowledge" is an all-encompassing concept. As C. Geertz has put it focusing on legal questions: "Like sailing, gardening, politics, and poetry, law and ethnography are crafts of place: they work by the light of local knowledge" (1, p. 167). Thus all aspects of culture rely on a complex system of thought which in its totality forms local knowledge. Therefore, local food knowledge or any other aspect of local knowledge is just one part of this complex system, which has an important meaning to the members of the culture. The challenge is to see "...the broad principles in parochial facts. "Wisdom", as an African proverb has it, "comes out of an ant heap"..." (1, p. 167).

These concepts do provide a strong theoretical foundation for working on the complex meaning systems of indigenous and "traditional" societies. However, *they clearly lack a systematic and detailed discussion of applied aspects of such knowledge systems.* There is no input from applied researchers or from anyone who is interested in preserving, disseminating or using this information. Therefore, it is essential to highlight another stream of thought, which does come specifically from such an angle - the concept of *Traditional Ecological*

Knowledge, which is also well known under its acronym TEK. This has been defined as "a body of knowledge built up by a group of people through generations of living in close contact with nature". It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that covers resource use. The quantity and quality of TEK varies among community members, depending upon gender, age, social status, intellectual capability and profession (hunter, spiritual leader, healer, etc). With its roots firmly in the past, traditional knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technological and socioeconomic changes of the present (2). Compared to Geertz's emphasis, TEK highlights the applied role of such knowledge system and is little interested in symbolic or other theoretical aspects.

The concept is very popular with activists and applied researchers in all fields, which involve the local and sustainable development of resources, the critique of outside involvement in such developments and most notably the implications of the Convention on Biological Diversity (CBD or Convention of Rio do Janeiro, 1992) (3). Despite of its at first glance apparent limitations to ecological knowledge it normally encompasses botanical, zoological geological, pharmaceutical and many other aspects of local knowledge. Many people now recognise the enormous contribution that traditional knowledge systems have made and can make in the future both to the conservation and the sustainable use of biological diversity. Most indigenous and local communities live in regions where the vast majority of the world's plant genetic resources are found. Simultaneously these activists and scholars argue for urgent action to safeguard such traditional knowledge and for a broad view of how humans and the environment interact. Importantly, this discussion proceeded with a focus on non-European indigenous groups while far less attention has been paid to the situation within Europe.

One of the important outcomes of the discussions on TEK systems, has been the broad recognition, *that a new relationship between researchers and "keepers of traditional knowledge" is needed*. Since it was agreed upon in 1992, the Convention on Biological Diversity has been at the centre of the discussions about equitable benefit sharing between the "South" and the "North". Some activists group argue for a complete ban on bio-prospecting or other research activities which have the potential of resulting in new economically exploitable products, while others argue for a novel relationship between keepers of traditional knowledge and (mostly "Western") researchers (see below).

These two related, but diverse streams of thought have been integrated in recent years as summarised very clearly by Luisa Maffi in a volume which addresses the link between linguistic and biological diversity and the need to counteract the linguistic and cultural erosion, which is taking place worldwide on an unprecedented scale:

"...landscapes are anthropogenic not only in the sense that they are physically modified by human intervention, but also because they are symbolically

brought into the sphere of human communication by language: by the words, expressions, stories, legends, songs and verbal interactions that encode and convey human relationship with the environment and inscribe the history of those relationships onto the land." (4, p. 12)

These are examples from a diversity of human activities as they relate to human's use of the environment. In the next section, we highlight this link specifically as it relates to the use of local food in the Mediterranean basin.

Local Food - a theoretical perspective

Food is an example which exemplifies local knowledge or TEK. Plants, fungi and animals that yield food are one of the most essential resources for all humans and of course an everyday need. At the same time, in many regions food is still produced or gathered in the immediate surroundings of the house or the community. Food is a very basic need, but - unless people do not suffer from starvation - also a pleasant experience. Food and dishes do always reflect a "vision of the world" and consequently peoples, ethnic groups and communities are proud of their special dishes and the plants or breeds of animal they produce and use. Such knowledge gives them a regional identity. However, it is well beyond the scope of this short overview to discuss the concept of "Local Food" on a world-wide scale. The Mediterranean TFK has sometimes been described as a diet mainly composed by pasta, olive oil, vegetables, fruits, red wine, sea-foods and only few red meats and was termed the "Mediterranean diet". More precisely Mediterranean TFK should be referred to as "Mediterranean *diets*" since the many different cultures, religious beliefs, ecologic backgrounds and historic developments around *the Mediterranean basin resulted in many diets, which share a multitude of elements, but also revolve around distinct local or regional traditions.*

However, how do we best define "local food"? In a geographical approximation, this clearly relates to ingredients which are gathered, grown or produced locally and prepared into dishes which often represent a local speciality. Such food is derived from animals, fungi and plants, but in the context of this discussion the focus is on food of botanical origin. Some of these local traditions have become world-wide phenomena (in a way a "global food") but this binary opposition does not really help in explaining the differences between what is only known locally with more widespread types of food. If one were to create a binary opposition, the alternative to local food would be food, which is commercialised well beyond the region where it is produced.

Globalisation has resulted in an increasing availability of similar foods in different cultures. Local knowledge from Naples, Italy was transformed into a world-wide food, now often considered to be a typical American dish. The pizza was brought over to the USA and on its onward journey back to many European countries it became an element of US-American cultures (even though without the discovering of the Americas the Aztecan "tomatl" would not have found its way onto

the Neapolitan pizza) and is now a prime example of a convenience food. This incorporation of new food species is, of course, not a new phenomenon, Turkish corn (Fuchs' Türkisch Korn) is included in many of the early European herbals like Fuchs, Brunswick and others. In fact, it refers to *Zea mays*, which, of course, is of Mesoamerican origin. Similarly, sweet and hot peppers (*Capsicum annuum* and *C. frutescens*) are now considered typical elements of the Hungarian and Balkan (as well as the Asian Indian) cuisine, but are again of American origin. A telling example comes from the Mediterranean. In recent years rocket salad (*Eruca sativa*, Brassicaceae) has become a new, popular food in certain sectors of the European Community. Some health benefits have been scientifically investigated (5). The aerial parts were originally well known only in the Central provinces of Italy (esp. Umbria) and it was an important food of the Ancient Romans, that later fell into disuse in most regions. Remnants of this widespread reputation in ancient times are the persisting local uses as flavouring agent in traditional dishes such as *gazpacho* of North Murcia and East Albacete provinces in southern Spain. Its leaves have a prominent, spicy taste and in recent years have become common ingredients of many salads in North and Central European countries. Thus rocket salad is a prime example of the transformation of a local food into a commercial product.

Another example was highlighted in our research in southern Italy, where horseradish (*Armoracia rusticana*) is commonly consumed as a condiment, most notably during the carnival period in spring. Ground horseradish is used to aromatise a sauce used with homemade noodles, or omelettes consumed during Carnival. It is a fascinating semi-cultivated species in the community of Castelmezzano (6). In Italy, semi-cultivated or naturalised horseradish is extremely rare and generally restricted to the northern and Alpine areas. In Castelmezzano, this local food is commonly "tolerated" in home-gardens and local people insist that it has always been part of the local cuisine. It is likely that horseradish came to Castelmezzano (and to a few other villages of inland Lucania) via migrants from Swabia in the 13th century.

Thus as a theoretical summary, local food may well have its origin outside of the regions of use and the crucial aspect of its definition is the local production, gathering or harvesting and consumption.

The "Local Food-Nutraceuticals" project and its goals

As pointed out above, in Mediterranean countries, the consumption of vegetables and fruits generally is considerably higher than in most North and Central European countries and the United States. Traditionally people all over the Mediterranean consume a diversity of plants, which are very often gathered from the wild. This part of traditions is the focus of the project "Local Food-Nutraceuticals" (LFN). The LFN project includes specialists in many fields like ethnobotany, pharmacognosy, pharmacology and nutritional studies which come from the UK, Germany, Poland, Spain, Italy, Switzerland and Greece. This

project is unique in the framework of the EU's programmes in being the first with a very strong focus on ethnobotanical questions and in being truly multidisciplinary bridging the gap between socio-cultural and natural sciences. As outlined above, the interest in local foods stems only in part from its potential as a lead source for novel nutraceuticals. Such food is an important element of local identity and a link of a community with its history.

Many local traditions are distributed over larger areas and exchange on a regional level reinforces their usage. However, many of these local traditions escaped the attention of a broader public in these regions or the political elite in charge. Therefore, from our perspective it is essential to highlight the character of such products as an element of a geographical well defined tradition. In many cases these uses can be traced back historically, in a few cases even back to Roman and Greek times (see the example of *Eruca sativa*).

The consortium includes researchers with expertise in a variety of fields allowing a study of such diets from a multifaceted perspective:

- ◆ University of London, The School of Pharmacy, Centre for Pharmacognosy and Phytotherapy, London, UK
- ◆ University of Murcia, Department of Plant Biology, Murcia, Spain
- ◆ University of Frankfurt, Biocenter Niederursel, Frankfurt, Germany
- ◆ Jagiellonian University, Faculty of Biotechnology, Krakow, Poland
- ◆ University of Milano, Department of Pharmacological Sciences, Milano, Italy
- ◆ Harokopio University, Department of Nutrition and Dietetics, Athens, Greece
- ◆ DSM Nutritional Products, Basel, Switzerland

On the one hand the Consortium contributes to the development of new nutraceuticals by identifying plants traditionally used in rural communities of southern Italy, Greece and southern Spain with potential health beneficial effects, but as importantly the project wants to give new values to local food products which have been used for many generations and which now are at the brink of becoming forgotten.

Specific goals of the project include:

- 1: Ethnobotanical documentation of food products of selected communities in southern Italy, Spain, Greece incl. Crete
- 2: Comprehensive understanding of the social, cultural, economical framework of local food use
- 3: Identification of active extracts/pure compounds (leads for new health food supplements)
- 4: Biochemical/pharmacological *in vitro* mechanisms/*in vivo* effects of selected species
- 5: Dissemination of ethnobotanical information in local/national languages

Before discussing this approach in more detail, it is essential to discuss the responsibilities of the researchers and their institutions involved in such projects.

Benefit sharing

As is apparent from the above, there are two distinct but connected lines of research activities in this project - the study of local food knowledge with the goal of making this of interest to future generations in the regions of origins and thus to contribute to sustainable local use of resources, and the study of the species' wider potential as nutraceutical/health foods. These two lines are in no way based on contradictory goals, but in fact interdependent aspects of one common goal - *the valorisation of local knowledge*. Such knowledge will only be "preserved for posterity" if it is of interest and value to the community and if it has the potential to contribute to local agriculture. Clearly the wider use of one or a few of these food products would be an opportunity for such a valorisation.

In order to ascertain appropriate benefit sharing between the regions of origin and the academic institutions involved in the project, the consortium has given itself a precise framework in the form of a consortium agreement. The overall vision is best summarised in the preamble of this agreement, which is legally binding for all partners of the project:

"It is the goal of this research project and the joint interest of all partners

- ◆ to evaluate food plants locally used in member countries of the EU and neighboring countries in nutrition which have recorded additional health benefits
- ◆ to characterise these plants with respect to their biological and pharmacological effects as outline in the Contract with the European Union and additions to it
- ◆ to study the pharmacological mechanism of action of selected plant extracts in order to better understand the biochemical mechanism and thus to evaluate these popularly used local food plants
- ◆ to contribute to the dissemination of knowledge about locally used resources in the member countries of the European Union with the long term goal of providing additional incomes to the regions of origin

It is the explicit principle that the botanical material provided by the partners and the various external partners (subcontractors and any other providers) should be provided under the principles as they are laid out in the 'Convention of Rio' and subsequent international agreements. Specifically plant samples will only be included in the research project if the provider presents documentary evidence that they have the permission from appropriate government authorities to collect these plants.

It is understood by all parties signing this agreement, that information on the bioactivity and chemical characterisation of collected species will not be used in conflict with the sustainable use of these resources and that endangered and

rare species are not to be over exploited, regardless of their potential as patentable pharmaceutical agents with commercial value.

Specifically mechanisms have to be set up for just compensation of indigenous groups or other traditional or local keepers of knowledge, if the plant samples provided by them yield economical benefits. It is recognised that this compensation refers to all commercial products such as nutraceuticals or pharmaceuticals, whose discovery and development is based, either directly or indirectly, on the traditional knowledge of the respective groups."

The most crucial aspect clearly relates to the potential of developing a patentable product, which could generate significant income for one or several of the partners involved. In such a case the Consortium "Local Food-Nutraceuticals" will set up a Trust Fund which will be in charge of the equitable sharing of the financial benefits of the project:

"In the event of payment to the Trust Fund a Benefit Sharing Fund will make donations to return to the country or region which supplied the botanical material to support conservation, health training and education at the community level or regional level when the source material originates from an uninhabited area" (Consortium Agreement "Local Food-Nutraceuticals", § 10.5.5). Of the total revenues 40% would be returned to the regions of origin.

Currently (Jan. 2005) no such product has been developed, but clearly the agreements remain legally binding for the future activities of the partners on the species included in this project.

The consortium agreement has been phrased in a way to allow for its use within the EU or beyond. We selected this model since the likelihood of developing promising new lead extracts or compounds is certainly higher than if one would have used a random approach, but it is still rather low. Therefore, such measures will only be implemented if needed. It has often been argued that the communities in which such research is conducted should be reimbursed for providing the knowledge as such without waiting for potential but highly uncertain future benefits. However, such funds were not made available under the fifth framework programme of the EU and on an EU-wide level the relevant policy issues on this local technological knowledge have not been resolved.

Wild gathered foods in selected regions of the Mediterranean

One of the main goals of the project "Local Food-Nutraceuticals" has been to conduct detailed nutritional-anthropological studies of selected local food systems and to contribute to an understanding of the local knowledge as it relates to this specific resource.

Wild gathered vegetables are a category of their own regarding folk taxonomic aspects but not as it relates to culinary art where wild greens are used in the most common recipe types. In Crete edible wild greens are called *vrouves* or *horta* while in Epirus they are called *lahana*. In Castellmezzano wild gathered greens are called

foglie (leaves) and also include semi-cultivated species (6) while in Gallicianó they are called *chòrta* (7) meaning greens as food or herbs. The people inhabiting the mountain ranges of Alcaraz and Segura of southern Spain do not use a term to describe wild gathered greens as a whole. Instead they use three terms to describe different groups of wild gathered greens: *collejas* describes the plants from which the young sprouts and leaves are used, *espárragos* describes those from which the young shoots are eaten like *Asparagus* sp., *Bryonia* sp., or *Humulus* sp. and the term *chicorias* refers to the Cichorioides (Asteraceae) consumed preferentially raw in salads like *Cichorium* sp., *Chondrilla* sp., *Taraxacum* sp., or *Leontodon* sp.

The gathering of wild greens is strongly seasonal. In the Mediterranean the wild greens are mainly collected from mid to late autumn until spring or early summer depending on temperature and precipitation. Fruits can be gathered in spring but mostly in autumn as can fungi. Many recipes with leafy wild greens include a broad range of species and reflect this seasonal aspect including variability in the use of species depending on seasonal availability. The recipe for the "minestra di erbe selvatiche" (soup of wild greens) included in the recipes collection "La Cucina della Sardegna" comprise "at least 18 wild herbs" such as: *Cichorium intybus*, *Papaver rhoeas*, *Foeniculum vulgare*, *Diplotaxis* sp., *Silene vulgaris*, *Beta vulgaris*, *Oxalis acetosella*, *Sonchus asper*, *Nasturtium officinalis*, *Crepis* sp., *Allium* sp. etc., and divers wild "cardoons" such as for example *Cynara cardunculus*, *Onopordum* sp. and *Scolymus* sp. (8).

Wild gathered greens are used in many different ways and prepared using diverse recipes according to local traditions. In southern Spain for instance soups and potato tortillas are a very prominent way to consume wild greens while in Greece vegetable pies are characteristic. In all three regions it is very common to fry them with eggs or with garlic and olive oil after having cooked them or to consume them raw in salads.

As an example of local food use, we concentrate our attention on a small Greek-Italian community called Gallicianó, located in the Graecanic area, region of Calabria in southern Italy. The Graecanic area is part of the cultural and linguistic heritage of the Magna Graecia (8th century B. C.) and the history of the later Byzantine Empire in southern Italy (9). During the period of the Magna Graecia, the whole eastern Mediterranean was dominated by Greek culture. Today, the Graecanic area has receded into the Aspromonte Mountains of the southern tip of the peninsula (Region of Calabria) and to Salento, in the Region of Puglia. The inhabitants of the Graecanic area, as compared to the surrounding Italian population, are characterised by their own language (*Grecanico*), culture and history as an ethnic and linguistic minority. They have retained many aspects of their cultural heritage, thanks to the geographic isolation of the villages. Pastoralism and subsistence agriculture are still very important in the area. The use of local food plants forms part of traditional systems of knowledge and practice that have developed and accumulated over generations. Most of the traditionally used non-cultivated food plant species are very valuable as

vegetable substitute in early spring. Wild greens are often available several weeks before garden varieties and contribute to a healthy and balanced diet of the community. As mentioned above, they have their own term in *Grecanico*, "chòrta", to describe wild edible greens in general. The same term "horta" (XOPTA, gr.) was found in literature to describe the wild food plants consumed in Greece (10).

In order to collect ethnobotanical information about traditionally used wild vegetables, weeds and neglected crops, participating observation, open and semi-structured interviews and plant collection were used during the fieldwork (March - May 2002, September - November 2002, and March - May 2003). Furthermore, specific cultural and social aspects of the area, as well as dietary patterns in the selected rural region were identified and provide comprehensive information on the social framework related to the nutritional behaviours in the selected rural area.

Elderly women in the village are the main "keepers of traditional knowledge" in the domain of local food plants, while men play an important role in gathering the plants and fungi that grow far away from the villages. Only very few of the younger generation, which are no longer fluent in the ancient language *Grecanico*, know the culturally most important wild edible plant species. Evidence from the field suggests that the loss of traditional *Grecanic* plant names risks to result in a decrease in the number and variety of plant species used. This reduces the role of healthy traditional foods in the local diet. In total, about 40 different wild food plant species have been identified, as for example *Reichardia picroides*, *Papaver rhoeas*, or *Sonchus oleraceus*. An example of a very local food is *Reseda alba*, which is heavily used as a vegetable in Gallicianó but not by Italian communities where the plant is considered to be too bitter in taste. The tops of the shoots are eaten raw seasoned with olive oil or after being cooked and then stir-fried with garlic and olive oil. Since no records from Greece about the usage of this plant exist, it is not clear whether this is a relict of ancient Greek culture or an independent acquisition.

Cognates of plant names are a good indicator of historical importance of species, if one can compare two geographically distant groups (31). Here they have been identified the Graecanic Area and Crete. For example, *Reichardia picroides*, which can be eaten raw as snack or cooked with other wild green plants, is called *Gaddazida* in Gallicianó and *Γαλατσιδα* (*Galatsida*) in Crete (11). Another example is *Sonchus oleraceus*, which is called *Zuccho* in Gallicianó and *Ζσόχοζ* (*Zóchos*) in Crete. It can be suggested that the use of these plant is a relict of ancient Greek culture and still part of a local traditional system of knowledge.

In conclusion, local food use in Gallicianó provides an example of the impressive food knowledge which still exists in many regions of the Mediterranean and how important it is to study such knowledge now.

Overall pharmacological approach and in vitro methods

One of the main goals of this project was to assess the diversity and the role wild gathered food plants play in local nutrition and cuisine, social-economy and as an identity factor responsible for their role in the communities. Another corner stone of the project was to characterise a significant part of the documented local food plants pharmacologically. In a short summary the pharmacological part of the project aims at taking a plant with recorded local culinary uses through a primary *in vitro* screening to a mechanistic secondary screening, an animal *in vivo* study and finally to a clinical intervention study with human volunteers. The strategy behind this multidisciplinary approach is to screen elements from a reportedly health promoting and disease preventive diet in a selection of relevant *in vitro* and *in vivo* screenings trying to identify the beneficial components.

Epidemiological studies, especially the "Seven Countries Studies", have drawn much attention towards the health beneficial dietary patterns of the Mediterranean region (12). The consumption of fruits, vegetables, olive oil and red wine have often been correlated with lower rate of coronary heart disease, diabetes, cancer, and with a greater longevity (13, 14). As a result of the different epidemiological studies many foodstuffs from Mediterranean diets were investigated in pharmacological screenings, clinical trials and in terms of their chemistry (15, 18). However, with the exception of very few studies (19, 20) wild gathered vegetables, grains, nuts and fruits for culinary uses have not been the focus of systematic pharmacological and phytochemical analyses.

Out of a total of around 320 vegetable and food species documented in Greece, Italy and Spain in this project (incl. the work of the partners from Murcia and Athens) around 125 were selected to be extracted with ethanol. In a set of primary screenings focusing on chronic and age related diseases like cardiovascular diseases, diabetes type 2, cancer, rheumatic disorders, Alzheimer and depression these extracts were tested for their potential in health promoting activities. Therefore, test systems able to detect antioxidant activities (DPPH, guaiacol oxidation assay, HOCl scavenging, lipid peroxidation assay), COMET-assay, xanthine oxidase inhibition, acetylcholine esterase inhibition, anti-inflammatory activities (iNOS inhibition, reducing TNF α synthesis, reducing NF κ B and AP-1 activation), modulatory effects on angiogenesis, eNOS activation, serotonin re-uptake inhibition, and PPAR- γ binding activity were implemented. Furthermore, all extracts were profiled using HPLC-MS and their polyphenol content was determined.

The most promising extracts were further evaluated in a mice feeding trial and a clinical intervention study with human volunteers (Eckert et al, Univ. Frankfurt, see this volume). It is, however, too early to review an overall outcome of this effort since research on specific plants is still ongoing.

Examples of species studied in vitro

In the following only a few examples will be highlighted showing some of the outcomes of the pharmacological angle of our consortium's research. Ethanolic *Cynara cardunculus* ssp. *cardunculus* (wild cardoon) extract showed one of the highest anti-oxidant effects in the guaiacol assay (about 95% at 0.2 µg/ml). In an oxy-haemoglobin bleaching assay 10⁻⁵M extract GAE (gallic acid equivalent) quenched 28% of HOCl, while Trolox quenched 55% at half the concentration (21). Furthermore, *C. cardunculus* ssp. *cardunculus* extract increased NO and prostacyclin release by PAECs (porcine aortic endothelial cells) 2.3 and 2.7 fold respectively at a concentration of 1µM/L GAE. In the same test system *Thymus pulegioides* (3017) extract (1µM GAE) enhanced the release of NO and prostacyclin by PAECs cells 1.3 and 1.9 fold respectively (22).

These results even though they refer to *in vitro* testing suggest that consumption of wild cardoon and *T. pulegioides* could help to maintain a proper vasomotion and to reduce the incidence of atherosclerosis (22). In the oxy-haemoglobin bleaching assay 10⁻⁵ M (GAE) *T. pulegioides* extract quenched about 38% of HOCl. Furthermore, the extract was found to strongly inhibit guaiacol oxidation (94% at 0.2 µg/ml) (21).

The extract of another thyme species (*T. piperella* - 2025) screened in the COMET assay was able to reduce oxidative DNA damage induced by 25µM H₂O₂ in a concentration dependent manner (0.1µg/ml =14%, 100µg/ml =22%) (Kapiszewska and colleagues, this volume).

In an experiment with human hepatoma HepG2 and HUVEC cells the consortium could show that *Scandix australis* (2009) extract at a concentration of 20µg/ml inhibited the IL-1 induced activation of the pro-inflammatory transcription factors NFκB and AP-1 by 50% (Stalinska et al., this volume). In the PPAR gamma assay relevant for potential anti-diabetic activity *S. australis* extract was found to have an agonistic action on the receptor but further analysis have to be carried out in order to identify the active component(s): (Fluehmann et al., unpublished).

Onopordum macracanthum (2021) showed strong anti-inflammatory activity in a model with murine vascular endothelial cells stimulated with TNFα and IL-1 suppressing the production of NO to 10% in comparison to control at a concentration of 5µg/ml. In an experiment with murine macrophages stimulated with LPS 0.1µg/ml *O. macracanthum* extract diminished TNFα production to about 20% of control (Strzelecka et al., this volume)

These examples highlight some of the results from the pharmacological side of the project and they demonstrate that species closely related to species which are rather well known (eg. taxa related to artichoke or thyme), which are however, chemically different, have an interesting potential.

Furthermore, based on the pharmacological data gathered, we wish to increase the awareness of the industry and other interest groups in such local resources in order to widen the market potential for local foods and encourage new local

developments for small scale industry like specialised restaurants, tourism and local botanical gardens. We hope that increasing interest in local resources will help to sustain their *in situ* conservation. On a wider scale the project is oriented towards the development of new nutraceuticals for the European market and beyond by eventually introducing new vegetables, extracts or pure compounds. Finally, it is intended to modify dietary patterns in consumer groups and to help increase consumer confidence.

Local food beyond the Mediterranean - possible contribution of Central and Eastern Europe

During the last two decades several clinical and epidemiological studies provided evidence for the health beneficial properties of the Mediterranean diets. The French paradox has been discussed widely (23) and is paralleled by the Greek (24) and Albanian paradox (25). Aside from some East Asian, mainly Japanese cuisines, no other diets have a better reputation and consequently have been investigated in more detail than the Mediterranean diets. In contrast, numerous epidemiological studies found high risks for cardiovascular disease and some cancer types for the populations of Central and Eastern Europe (26, 27). This may have contributed to the fact that dietary traditions in Eastern Europe gained considerably less attention compared to certain Mediterranean traditions. However, several encouraging sets of data point to the potential of a more comprehensive view on local food traditions of Eastern Europe.

In contrast to the Mediterranean basin, Eastern Europe is less biologically diverse and a pronounced winter period in which agricultural practice is not possible requires the development of numerous storage practises. Therefore, the availability of cultivated fruits and vegetables but also of wild gathered greens is restricted to the relatively short summer which in turn increases the importance of cultivation of easily storable crops, and conservation practices which secure a balanced food supply during winter time.

Central and Eastern European diet is not only characterized by high meat and saturated fat consumption but also by the use of wild berries, mushrooms and especially by the tradition of preparing conserved foods such as sauerkraut, pickled cucumbers, onions, and garlic. The cultivation and processing of cabbage and root vegetables is probably the most efficient strategy to deliver essential plant constituents throughout the year. Beside the ubiquitous potato as a cheap carbohydrate source imported from America, we find a traditional high consumption of "low value grains" rye, barley, oats, spelt (German wheat) and buckwheat (*Fagopyrum esculentum*) instead of wheat and corn. Of course, they are cultivated due to climatic and edaphic conditions, but in western understanding the use of these seeds and integral flour as well as bacterial fermentation (sourdough) instead of yeast-based one is no longer associated with poverty but with a variable and healthy diet.

Historical and political conditions caused a certain persistence of local knowledge in Central/Eastern Europe. Until the mid-20th century, when limited variability of the available food types resulted in a focusing on basic needs, the development and conservation of TEK was certainly quite similar to other European regions. Since the beginning of the fifties improving socio-economic status and internationalisation of the food market in most Western societies altered the role of traditional wild food. When in the beginning of the 1980ies these came *en vogue* again for the exotic amplification of food habits, a huge quantity of popular collecting and cooking literature was published. For instance, in West Germany and Austria this knowledge was taken quite often from the impressive literature on wild herbs, fruits, vegetables etc. mostly published between the 1930ies and the 1950ies, a period during which war and post war starvation made wild sources crucially important.

In contrast, until 1990 we find a continuous stream of publications on the use of local resources in so-called socialist countries. While the central political system did not directly support the local production of food, the modest standard of living did result in the creation of niche markets and the local production of foods for self consumption. This was of course, largely due to the facts that on the one hand the industrial food production was neither effective nor sufficient and that on the other hand food imports were quite unpopular for both political as for economic reasons. Thus, private small scale initiative flourished not only to enrich the monotonous offer of affordable basic food, but also to sell those home-grown products (niche markets). Subsidised by the state, it could be an important income for some families. This includes cultivated fruits and vegetables as well as wild gathered berries, mushrooms and herbs. The economic limitations also encouraged the private low scale domestication of poultry, pigs and rabbits as much as fishing and apiculture were not simply a hobbyhorse. An interesting recent example of such a home-grown food is *pru*, a refreshing drink traditionally produced and consumed in a restricted region of Eastern Cuba that became popular in the 1990'ies in the whole of Cuba as a result of the economic crisis and the disappearance of industrial soft drinks (32).

In the post-Soviet period we find two counteracting trends:

- ◆ The globalisation with massive food imports from the West and increased variability in food supply and
- ◆ Since supermarket imports are not affordable for all, a new interest in the own local food resources,

In summary, Central and Eastern Europe have seen a need for such products as emergency and supplementary foods. The current transition to more market-driven and prosperous economies results in local resources being considered to be of less interest and therefore such knowledge is likely to disappear fast. However, where the political change caused the total collapse of the economy and food availability, the new poverty resulted in a renewed or enforced reliance of their

populations on local resources (e.g. some countries in the Balkan countries). *Under both conditions, the study of such traditions is essential and urgent.* While nutritional habits change and contemporary western lifestyle and advertisement influence more and more the younger generation, the local traditions are still alive among the elderly rural population, though presumably undervalued and underestimated. Some of these food habits, which were forced on people by need may not be fully appreciated, worth for conservation or object of a serious scientific research. This and the fact that most of the information is only available in Central or Eastern European languages might explain the low attention given to the rich and still surviving TEK in Eastern and Central European countries and specifically to their local food traditions.

In the following, some prominent examples of Central/Eastern European food plants highlight the opportunities of a more systematic investigation of such TEKs. Some of these in fact have gained high recognition on the international level, as parts of other diets. Fermented cabbage (*kiszona kapusta* pl; *kyselé zeli* čz; *sauerkraut* dt.) is a rather popular ingredient of the Korean cuisine (*kimchi*) and now recommended in different diets. In some countries horseradish (*Armoracia rusticana*, see also above), is probably more often consumed and appreciated in combination with *sushi* as falsification of the original Japanese green *wasabi* (*Wasabia japonica*) and its origin as an element of the Polish cuisine is not recognised. In Poland horseradish-based mayonnaise is commonly used with ham and kielbasa (sausages), especially in Easter time. Red beetroot (*Beta vulgaris var. conditiva*), probably the most famous ingredient of Polish and Russian soups, is a widely used vegetable in South Indian dishes. However, traditional raw and pickled uses or pressed juices of red beetroot (e.g. "barszcz czerwony" red beetroot soup) are little known and appreciated outside their regions of origin.

The currently highly advertised cranberry (*Vaccinium macrocarpon*), mostly imported from North American cultivation, has its European analogues (esp. *Vaccinium vitis-idea*) and together with bilberry (*V. myrtillus*) a long tradition in Central/Eastern Europe nutrition and local medicine. In recent years, the content of resveratrol, anthocyanidins and other constituents in those fruits has been compared to the Mediterranean grape. Similar developments are to be expected for some other wild or semi-domesticated fruits with interesting properties such as sea buckthorn (*Hippophaë rhamnoides*, seed and flesh oil), blackthorn (*Prunus spinosa*), wild roses (*Rosa spp.*), *Aronia melanocarpa* (originally from North America, but cultivated in Eastern and Central Europe for many decades), *Sorbus domestica* or *Sambucus nigra*. These species are obviously not restricted to Eastern Europe but have been exploited traditionally more intensively in Eastern and Central Europe (often supported by the so-called socialist governments of the time).

Considering the lack of recognition of even well established "Eastern European" food plants and the lack of modern studies on their health benefits, it would be useful to look beyond the Mediterranean at other nutritional traditions:

- ❖ Is olive oil generally superior to other PUFA rich oils used traditionally in Central/Eastern Europe as such linseed oil (*Linum usitatissimum*, Germany, Poland) or pumpkin seed oil (*Cucurbita pepo*, Austria, Slovenia)? Or is it vice versa?
- ❖ Is the Turkish or Greek halva (modified pressing residue from sesame seed *Sesamum indicum*) healthier as Russian halva from sunflower (*Helianthus annuus*)?
- ❖ Is the Mediterranean oregano (*Origanum vulgare*) better than the northern equivalent marjoram (*Origanum majorana*)?

In summary, there exist good reasons to extend the study and preservation of local knowledge via systematic investigation to other European regions other than the Mediterranean:

1. The Central/Eastern European cuisine with a more limited number of food species used probably contributes a high variety of different forms of conservation and preparation of specific plant parts from a variety of sources: The effects of these have so far not been investigated in detail.
2. The higher risk of coronary diseases in Central/Eastern Europe might not be due largely to "wrong" food habits, since in these studies other factors such as physical activity and different social and environmental (stress) factors have rarely been studied simultaneously. Also, nutritional pattern in Eastern and Central European countries are no longer very different from other European diets and are less seasonal as had been expected [cf. Dusinska et al. (28) on the blood antioxidant status in healthy middle aged young men in Bratislava (Slovakia) (29)].
3. Due to historical and political reasons there presumably will be well preserved local food knowledge in Central and Eastern Europe. As with other diets these local traditions were shaped by climatic conditions and socio-cultural factors. Poverty and isolation from a global food market, which lasted until recently, were driving forces in these developments. These cuisines are tasty and unique responses to local needs. Even though this knowledge may currently not be very much esteemed, it is still known to and used by the older, rural population. Importantly, it should not be considered as a putative part of a communist heritage but be investigated as part of Europe's diverse traditions and integrated into a European context of nutrition.

General Conclusions

The overview has covered a huge terrain and a variety of disciplines. Many other aspects are of relevance and, for example, the local promotion and strengthening of such food traditions has been a central task of the EU-funded project, for example, by developing new didactic materials for schools or handbooks for dissemination (7; 30). While the general public and some researchers often see such ethnobotanical information as a source of inspiration

for "us", the continued knowledge and use of these resources in the regions of origin will require not only their recognition as local knowledge or traditional ecological knowledge, but also their study and development from a multidisciplinary perspective. Clearly, this is only possible if the "traditional keepers" of this knowledge have a say in its future use and benefit from such research and development.

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