

FERMENTED FOODS FOR FOOD SECURITY AND FOOD SOVEREIGNTY IN THE BALKANS: A CASE STUDY OF THE GORANI PEOPLE OF NORTHEASTERN ALBANIA

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Traditional foodways are critical not only to food sovereignty in emerging and developing countries, but also to food security, eco-touristic development, small-scale food specialty markets, and local health strategies. We explore traditional knowledge concerning the fermentation of local plants (ethnozymology) for the production of medicinal and folk-functional foods perceived to have general health benefits. Field research was conducted in two Gorani communities in the mountains of NE Albania, located near the Kosovar border. Interviews were conducted with 44 study participants, and the fermentation of 15 plants for health purposes concerning disease prevention and health promotion was recorded. We discuss the role of fermentation in the production of local foods for health and its connections to community vitality and food security generally.

Keywords: *lactic acid fermentation, functional foods, probiotics, Balkans, ethnobotany, ethnozymology*

Tradicionalni načini ishrane su ključni ne samo za suverenost hrane u novostvorenim i nerazvijenim zemljama, nego i za bezbednost hrane, eko-turistički razvoj, mala specijalizovana tržišta hrane, kao i lokalne strategije zaštite zdravlja, takodje. Mi smo ispitivali tradicionalno znanje o fermentaciji lokalnih biljaka koje se koriste u proizvodnji funkcionalne hrane i hrane sa lekovitim svojstvima za koju se smatra da može da ima uticaj na poboljšanje opšteg zdravstvenog stanja. Istraživanja na terenu su sprovedena na dve zajednice Goranaca planinskih područja u severoistočnoj Albaniji, blizu granice sa Kosovom. Interjui su obavljeni na 44 ispitanika i obuhvatili su studije fermentacije kod 15 biljnih vrsta u vezi sa njihovim uticajem na sprečavanje bolesti i blagotvornim dejstvom na zdravlje ljudi. Mi smo razmatrali ulogu njihove fermentacije u proizvodnji lokalne hrane radi zdravstvene dobrobiti ljudi, kao i njihove veze sa vitalnošću lokalne zajednice i opštom bezbednošću hrane.

Introduction

People have used and relied on fermentation as a means of processing foods for millennia (Etkin 2006). The advantages of this process are multifold and include: 1) diminishing undesirable elements of the raw product (i.e., toxicity); 2) improving food digestibility and nutrient availability; 3) enrichment of the food with vitamins and amino acids; 4) reducing cooking time (because the food is pre-digested, cooking time is reduced or eliminated as a preparation step); 5) salvaging food waste; and 6) improving shelf-life and decreasing spoilage (Etkin 2006). Zymology, also known as zymurgy, is a term used to describe the science of fermentation. In particular, it concerns topics such as the study of microorganisms (yeast and bacteria) responsible for fermentation, the biochemical

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pathways involved, and other topics related to the processes of making fermented foods and beverages.

While the term *zymology* is relevant to food production that incorporates specific, known (allochthonous) starter culture organisms, the term *ethnozymology* might be more appropriate for describing the science of fermentation in traditional diets. Specifically, this term is relevant for describing the integration of traditional ecological knowledge (TEK) in the production of fermented foods, which rely on the fermentation potential of the autochthonous microbiota found on the plant ingredients and from other natural sources.

The need for an ethnomicrobiological perspective in ethnobiology (Nabhan 2010) is not only related to the growing interest in high-quality local food specialties, but also to the fact that this represents an important portion of the *invisible* biocultural landscape and of the *terroir* (Bérard et al. 2005) of a certain place. The *sense of place* in sensory terms in the cuisine (Redzepi 2010) is, in fact, not only based upon the agro-biodiversity of locally gathered, cultivated, and processed plants and animals (food ethnobotany and ethnozoology); locally managed soils (ethnopedology) and environments (ethnoecology); and traditional agricultural and pastoral techniques and ways of cooking; but also by culinary processes where a crucial role is played by *invisible* microbiota. These organisms are prototypical for a certain place and are able to generate unique fermentations and ultimately unique tastes and textures in final food products and dishes. Local knowledge concerning environmental resources involved in food production is thus a valuable factor in the process of food preservation and maintenance of food security.

Biodiversity, Food Security, and Food Sovereignty in the Balkans

The geographic features of the Balkans—encompassing the countries of Albania (Figure 1), Bosnia and Herzegovina, Bulgaria, Kosovo, Macedonia, Montenegro, Serbia and parts of Romania and Croatia—offer a unique opportunity to study the high biocultural diversity of a mountainous terrain that is the home of rich, intertwined, multicultural and multireligious communities. In fact, this area of southeastern Europe has increasingly become the focus of ethnobotanical field studies that share a common goal of documenting and conserving traditional knowledge of plant use by the people of this region (e.g., Menković et al. 2011; Mustafa et al. 2012; Pieroni et al. 2011; Redžić 2006; Rexhepi et al. 2013). In addition to the medicinal use of plants in this region, many wild plants are also commonly used in the context of foods (serving the purposes of meeting basic dietary/nutritional needs), medicinal foods (consumed to obtain specific medicinal action), and folk-functional foods (consumed for their general perceived health value, i.e., being considered “good for you” [Pieroni et al. 2002a; Redžić 2006]). While much work has been done on the documentation of wild foods in the Balkans, traditional knowledge of plant processing via fermentation is an area that has yet to be explored in great detail.

The process of food fermentation plays a crucial role in “providing food security, enhancing livelihoods and improving the nutrition and social well-being of millions of people around the world, particularly the marginalized and vulnerable” (Battock and Azam-Ali 1998). The state of global food security has

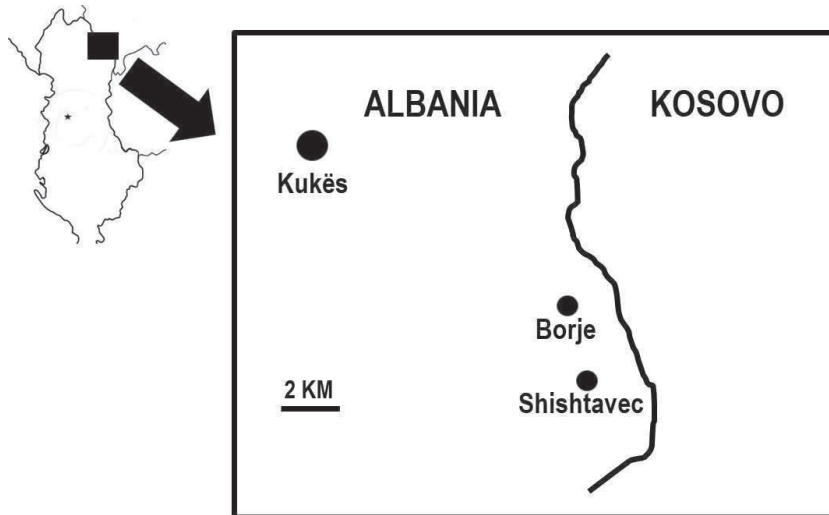


Figure 1. Map of the study area. Fieldwork was conducted in the Gorani communities of Borje and Shishtavec, located along the Albania-Kosovo border, southeast of the city of Kukës.

been a point of intense focus by the Food and Agricultural Organization of the United Nations (FAO). The World Health Summit (1996) brought attention to this issue, explaining that “Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” A recent FAO (2013) report highlighted the complexity of the condition of food security, which is best understood through the lens of several dimensions that are linked to a suite of specific indicators (Figure 2). Specifically, food security is influenced by: 1) the availability of sufficient quantities of food of appropriate quality; 2) access to adequate resources for acquiring appropriate foods for a nutritious diet; 3) utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being; and 4) access to food at all times, not to be impeded by sudden shocks such as economic or climatic crisis or cyclical events due to seasonal food insecurity (FAO 2006).

Concepts of food sovereignty, on the other hand, bring to the discussion more elements concerning how food is provisioned. In this context, more emphasis is placed on the value of local, culturally appropriate food provisioning instead of imports from global agribusiness. This is best summarized by the Declaration of Nyéléni (2007:1):

Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations.

Thus, local knowledge, and TEK in particular, is highly relevant to the persistence of local food traditions and support of food sovereignty.

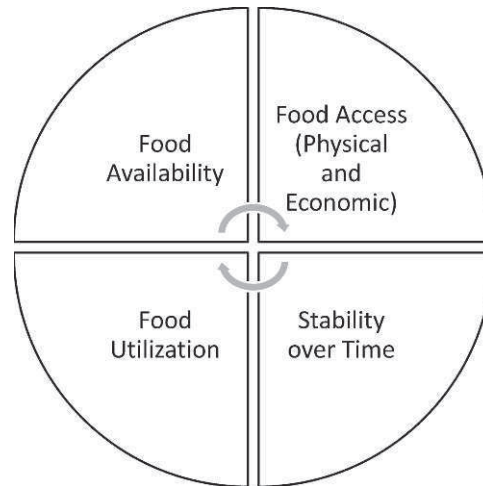


Figure 2. The widely accepted definition of food security points to four core dimensions (Adapted from FAO, IFAD, and WFP 2013).

The aim of this paper is to review and discuss the fermented foods and beverages prepared and consumed by the Gorani people of northeastern Albania, their perceived health benefits, role in the traditional local diet and implications for local food security and food sovereignty. Following a description of the study area, methods, and results, we take a systematic approach in reviewing the role of TEK in fermentation, citing various examples of how local knowledge is crucial to the creation of health foods and beverages in this region.

Study Area

The Gorani

The Gorani are one of several ethnic minority groups living in the southwestern Balkans (Figure 1) and one of the official ethnic groups recognized by the Republic of Kosovo. They represent a South-Slavic minority of Muslim faith, with a few dozen small communities located in mountainous regions across Albania, Kosovo, and Macedonia. In the study area of northeastern Albania (Kukës district), there are only a few Gorani communities. The Gorani speak a unique language, which they define as *našinski*, and which is a Torlakian transitional dialect between the Bulgarian/Macedonian language group and the Serbo-Croatian language (Browne 2002). The Gorani people have a strong sense of cultural identity, and tend to refuse classification with the Serbian, Macedonian, or Bulgarian groups. There are estimated to be around 30,000 Gorani in the Balkans, but migration and urbanization heavily affected the communities in the recent years, especially in Kosovo and in Albania.

Field Site

Field research was conducted in the Gorani communities of Borje and Shishtavec (Šištavec), located in the Šar Mountain complex, along the Albania-Kosovo

border in northeastern Albania (Figure 1). This border region still wears the scars of war as active landmines from the Balkan conflict of the 1990s remain buried in unmarked locations not far from these communities. The mountainous-hilly terrain of this region also contributes to the physical isolation of the communities, with the largest urban center (Kukës) being accessible by narrow dirt mountain roads that are difficult to travel due to rough road conditions and occasional blockages by landslides. The landscape is dominated by the snow-capped peak of Mount Gjallicë (2,486 masl) and the terrain near villages is covered with terraced fields, where seasonal vegetables and local staples of potatoes and rye (nowadays for animal fodder) are grown.

The climate of this mountainous area is characterized by very harsh, continental-Balkan winters, with heavy snowfalls, which severely limit the mobility of the locals for several months each year; these harsh conditions contribute to a state of seasonal food insecurity. Thus, the inhabitants of these isolated mountain communities must be self-sufficient to survive these long, harsh winters. Specifically, the foodscape in these volatile periods relies heavily upon homemade dairy products and plant-based fermented products.

Materials and Methods

We conducted in-depth, semi-structured interviews concerning traditional food and health strategies with 44 informants (all over the age of 18) during the months of May and June 2012. In this paper, we address just a portion of this larger study of traditional health strategies (conducted by Pieroni and Quave), focusing on lacto-fermented foods and beverages. Interviews were conducted in the Gorani dialect with the help of a simultaneous translator. Prior informed consent was always verbally obtained before conducting interviews, and researchers adhered to the ethical guidelines of the American Anthropological Association (2012). During the interviews, informants were asked to show the quoted plants. Voucher specimens and digital photographs were taken for all the quoted wild plants, when available. Taxonomic identification was conducted by the second author and plant nomenclature follows *Flora Europaea* (Tutin et al. 2010), The Plant List database (2010), and the Angiosperm Phylogeny Group III system for family assignments (Stevens 2012).

Results

A total of 15 different species were cited by informants as being subjected to processing via fermentation prior to consumption as medicinal food or folk-functional foods (Table 1). In most cases, lactic acid fermentation was the primary means of processing, however in a few cases (*Cornus mas* L., *Malus sylvestris* L., and *Prunus domestica* L.) acetic acid fermentation was used to produce vinegar, which was commonly used in topical applications for the treatment of headaches. Alcoholic fermentation was reported for only two taxa (*Prunus cerasifera* Ehrh. and different landraces of *Prunus domestica*), for which it

is used to make a social beverage (*rakia*) that also serves some medicinal purposes (i.e., for treatment of toothache and halitosis). The number of spontaneous use reports of fermented plants was relatively low (ranging from 2–14%); this could be explained by the fact that these data were culled from a broader study on medicinal plants and participants were not asked specifically about the use of fermented beverages and foods. In all cases, the autochthonous microbiota found on the plants was employed to foster the fermentation process.

Discussion

Lactic Acid Fermentation of Foods

Lactic acid bacteria (LAB) occur naturally on fruits and vegetables (Di Cagno et al. 2013), and it is typically the autochthonous microbiota that are utilized in traditional fermentation procedures. In other words, the use of commercial allochthonous starter cultures is not necessary. The complex composition of microbiota is really dependent upon the unique niche provided by the particular plant and the conditions under which the fermentation is performed. This niche is influenced by factors such as the plant's chemical composition, competition from other microbiota in the environment, and other naturally occurring antagonists. Factors such as harvesting conditions and temperature can also influence the composition of microbes associated with the plant, and thus impact the fermentation process (Buckenhuskes 1997; Di Cagno et al. 2013). Some advantages of using the autochthonous microbiota are: 1) the ease of production (low cost); 2) limited number of necessary ingredients, typically only requiring the plant material, water, and sometimes salt (used in some cases to diminish growth of microbes that cause spoilage); and 3) health benefits of the by-products created by diverse autochthonous species.

Homolactic acid fermentation, in particular, results in the conversion of pyruvic acid (an end product of glycolysis) to lactic acid. The most commonly used genus in commercial applications for food production is *Lactobacillus*, though many nonpathogenic species from other genera are found in the traditional, small-scale production of lacto-fermented foods. Examples of these are *Lactococcus*, *Streptococcus*, *Leuconostoc*, and *Pediococcus*, among others. The health benefits of lactic acid fermented foods in general have been well documented, with impact both inside and out of the gastrointestinal tract. In particular, probiotics from these foods have been found to have particular utility in the management of inflammatory diseases and their use has been suggested for the treatment of a wide range of conditions including cardiovascular disease, diarrhea, gastroenteritis, irritable bowel syndrome, inflammatory bowel disease, cancer, depressed immune function, inadequate lactase digestion, infant allergies, failure-to-thrive, hyperlipidaemia, hepatic diseases, *Helicobacter pylori* infections, and many others (Parvez et al. 2006).

Interestingly, studies have also shown that lactic acid fermentation of certain plants can greatly increase the composition of phenolic compounds in the end product, thus boosting the antioxidant potential of the resulting foodstuffs (e.g., Filannino et al. 2013; Rodríguez et al. 2009). The enriched antioxidant activity of

Table 1. Local plants that are processed via means of fermentation and used for medicinal purposes.

Scientific name [voucher ID] ^a	CW ^b	Gorani name	English name	PU ^c	Preparation	Local use
Brassicaceae						
<i>Brassica oleracea</i> L.	C		Cabbage	Le	Lacto-fermented in salted water, the resulting liquid drunk	Healthy beverage
Cornaceae						
<i>Cornus mas</i> L.	W	Dren	Cornelian cherry	Fr	Fermented in water for a few weeks to produce a gassy fruit beverage Fermented to produce vinegar	Drunk with sugar as a refreshing beverage; Considered healthy for the heart and used to treat hypertension Food use; Applied to the forehead to treat headaches
Cupressaceae						
<i>Juniperus communis</i> L.	W	Smreka	Common juniper	Ga	Fermented in water for 40 days. The resulting liquid is sour in taste.	Consumed as a healthy beverage and for treating kidney problems and colds
Ericaceae						
<i>Vaccinium myrtillus</i> L.	W	Čaršikle, Čeršikle, Čeršine Boronica	Bilberry	Fr	Fermented in water	“Makes the blood thinner”; Healthy beverage; Flu-remedy; Diarrhea remedy
Fagaceae						
<i>Fagus sylvatica</i> L.	W	Buk	European beech	Ba	Macerated in cold water for 3 days	Resulting liquid is added to milk as a starter culture for yoghurt production (in the past)
Gentianaceae						
<i>Gentiana lutea</i> L.	W	Čemerika	Yellow gentian	Ro	Dried, then macerated in water for 2 weeks	Resulting liquid is drunk for healing the “seven illnesses” (panacea) and for treating stomachache
Rosaceae						
<i>Malus domestica</i> Borkh.	C	Jaboko	Apple	Fr	Fermented in water	Healthy beverage

Table 1. Continued.

Scientific name [voucher ID] ^a	CW ^b	Gorani name	English name	PU ^c	Preparation	Local use
<i>Malus sylvestris</i> Mill.	W	Shumska/ divje jabučica	European crab apple	Fr	Crushed and mixed with water, fermented Fermented to produce vinegar	Healthy beverage Applied to the forehead to treat headaches
<i>Prunus cerasifera</i> Ehrh.	W		Cherry plum	Fr	Fermented (alcoholic pathway) and distilled to make a liquor (<i>rakia</i>)	Social beverage; Topical applications for toothache; Mouthwash for halitosis
<i>Prunus domestica</i> L.	C	Sliva	Plums	Fr	Fermented to produce vinegar Fermented (alcoholic pathway) and distilled to make a liquor (<i>rakia</i>)	Applied to the forehead to treat headaches Social beverage; Topical applications for toothache; Mouthwash for halitosis
<i>Prunus spinosa</i> L.	W	Belausdre	Sloe	Fr	Crushed and fermented in water to produce a gassy fruit beverage	Healthy beverage
<i>Pyrus communis</i> L.	C	Kruška	European pear	Fr	Crushed and fermented in water to produce a gassy fruit beverage	Healthy beverage
<i>Pyrus pyraster</i> (L.) Du Roi	W	Kruška divije	European wild pear	Fr	Crushed and fermented in water	Healthy beverage
<i>Rosa canina</i> L.	W	Šip, Šipunka	Dog rose	Pf	Crushed and fermented in water	Healthy beverage
Solanaceae						
<i>Lycopersicon esculentum</i> Mill.	C		Tomato	Fr	Lacto-fermented in salt and water	Fruit eaten as food; Liquid given to livestock to treat helminthic infection

^a Vouchers collected whenever possible.

^b Cultivation Status. C: cultivated. W: wild.

^c Parts Used. Ba: bark; Fr: fruits; Ga: galbuli; Le: leaves; Pf: pseudofruits; Ro: roots.

these foods, in turn, improves the anti-inflammatory activity exhibited upon consumption. One specific example of an antioxidant-rich (due to carotene and anthocyanin content) fermented product is the Turkish lactic acid-fermented beverage *shalgam*, which is made using a process of autochthonous fermentation of black carrots, or *Daucus carota* ssp. *sativus* var. *atrobens* Alef. (Kammerer et al. 2004; Tangüler and Erten 2013). Wild foods, in particular, play a crucial role in traditional diets and may be processed in a number of ways (including as fermented beverages) to maximize utility and longevity of the plant materials (Rampedi and Olivier 2013). Understanding the bioactivity of wild plant resources (especially those transformed through fermentation) in the human diet and their respective role in health is critical to the maintenance of traditional foodways, food security and food sovereignty overall.

Some other general examples of foods produced via lactic acid fermentation include, Korean kimchi, cucumber and other vegetable pickles, Russian kefir, Egyptian *kishk* and Greek *trahanas* (yoghurt/wheat mixtures), sourdough bread, olives, capers, and Ethiopian *injera*, among many others (Steinkraus 1997). A number of studies have focused on the isolation and assessment of lactic acid bacteria (LAB) from traditional/ethnic homemade fermented plant-based foods consumed in diverse locations such as the Himalayas (Tamang et al. 2005, 2009), India (Tamang et al. 2008), China (Miyamoto et al. 2005), and Turkey (Kabak and Dobson 2011). With regards to commercial applications, recent market trends have demonstrated a rising popularity of probiotic supplements and foods, “natural” foods, and health beverages (Prado et al. 2008). These foods are considered to be minimally processed while also having advantages such as high nutritional value and health-promoting properties, yet also being low in sugar and very flavorful (Altay et al. 2013). Despite growing public interest in these foods, most people are familiar only with the most common lacto-fermented foods like yoghurt and sauerkraut, which are produced on an industrial scale using allochthonous starter cultures for widespread consumption, and few are familiar with the many other lacto-fermented foods and beverages consumed in traditional diets around the world.

Metabolic Pathways of Lactic Acid Fermentation

The carbohydrates available for the lactic acid fermentation of most fruits and vegetables include glucose, sucrose, and fructose. LAB achieve fermentation in two ways: 1) the glycolytic; and 2) phosphoketolase pathways. Homofermentative LAB metabolize hexoses via the glycolytic pathway to produce mainly lactic acid. Heterofermentative LAB, on the other hand, convert glucose to lactic acid, acetic acid or ethanol, and CO₂. Gas production (CO₂) can result from the fermentative breakdown of a number of different compounds, including malate, citrate, tartarate, histidine, tyrosine, arginine, glutamic acid, and lysine. Malate, in particular, is found in substantial amounts in fruits and vegetables and is subject to degradation by a wide variety of LAB (Fleming et al. 1985).

Fermented Beverages (Fruit “Sodas”) for Health

Among the Gorani, the fruits of local wild and cultivated plants (Table 1) are fermented to produce a type of non-alcoholic, non-salted, gassy fruit beverage, all



Figure 3. The fruits of *Prunus spinosa* L. are crushed, mixed with water, sealed in a large jar as depicted (ca. 30 cm wide, 60 cm tall) and left to ferment, eventually forming a gassy fruit soda that is filtered and drunk as a source of refreshment and for its general health boosting properties. Following the fermentation, the fruit soda is then strained and the liquid is typically transferred to empty 1 L plastic bottles (i.e., used Coca-Cola bottles) for storage and daily use (Photograph by Cassandra Quave).

of which are consumed for their refreshing quality and perceived health benefit (Figure 3). These beverages are created in an anaerobic environment (using sealed bottles) and sugar is sometimes added during the fermentation process to feed the culture and increase gas production (in the form of CO₂). The health benefits of these beverages are multifold, and the ease of preparation makes them a common household staple as a source of nutritious, potable beverages. Moreover, these non-alcoholic beverages are culturally appropriate for the Gorani as the use of alcoholic beverages is not permissible in the Islamic faith.

These beverages are not produced solely for the purposes of food preservation or enjoyment, but are rather specifically used in a folk-nutraceutical context. In a previous study of wild foods (*liakra*, weedy greens) among an Albanian diaspora in southern Italy, we explored this concept of folk-functional foods, which are considered to be generically healthy and consumed for their perceived health-benefiting action (Pieroni and Quave 2006). These are distinct from medicinal foods, which are consumed both for specific health purposes and the treatment of particular ailments (see discussion of medicinal beverages below).

While the Mediterranean diet complex has received much attention in recent years, and is characterized as being low in red meat consumption and abundant in fruits, vegetables, legumes, and olive oil, with moderate amounts of red wine consumption (e.g., Trichopoulou and Lagiou 1997; Trichopoulou et al. 2003), little

attention has been paid to other aspects of traditional diets in this region. For example, we have argued that the traditional consumption of wild bitter greens (Pieroni et al. 2002a), which are known to exhibit high antioxidant activity (Pieroni et al. 2002b), may also play a critical role for health in the Mediterranean.

Within the broad context of traditional foodways, the benefits of these fermented beverages are worth noting as they likely contribute to the health effects known to be associated with the Mediterranean dietary complex. Fermentation of flavonoid-rich starter materials (such as the plants specifically chosen for the production of fruit sodas) can result in the production of not only a more nutritious end product (in terms of vitamins and nutrients) but also one that is even richer in bioactive secondary metabolites (Paredes-López et al. 2010; Rodríguez et al. 2009). For example, a study on pomegranate (*Punica granatum* L., Rosaceae) found that levels of ellagic acid and antimicrobial activity of the end product was increased following lactic acid fermentation.

It is noteworthy that of the plants used in the preparation of fermented healthy beverages by the Gorani, the majority are from the Rosaceae family (Table 1). These and the other species reported here all share a common trait in that they are rich in plant flavonoids, which are known to exhibit both antioxidant and anti-inflammatory properties. Exogenous antioxidants, when incorporated into the diet in moderate to high levels, improve human health via quenching of free radicals and diminishing the damaging levels of oxidative stress and inflammatory processes in the body (e.g., Da Costa et al. 2012). This is of particular importance with regards to immune function and the chronic diseases that plague much of the Western world, including cardiovascular disease, diabetes and cancer.

Plant-Based Fermented Medicinal Beverages

Certain plants cited by Gorani informants as being fermented are used in a more strict medicinal food context (rather than as a healthy food or nutraceutical). One example of a medicine prepared via fermentation is that of *čemerika*/yellow gentian (*Gentiana lutea* L.) roots. The bitter liquid resulting from fermentation of the roots in water is used in the treatment of stomachache and as a panacea. Likewise, the fermentation of *smreka*/juniper (*Juniperus communis* L.) galbuli results in the production of a very sour product, which is used in the treatment of kidney problems and as a cold remedy, as in other South-Slavic areas (Pieroni et al. 2011). The sour nature of the beverage is indicative of its chemical makeup. Studies have shown that decoctions of juniper “berries” (galbuli), which are also used in Turkey for the treatment of kidney infections, are rich in flavonoid content, with antioxidant and antimicrobial activity (Miceli et al. 2009). It would be of great interest to determine how the fermentation process affects the phytochemistry of the beverage. For example, does this process improve the bioavailability of flavonoids with antioxidant and antimicrobial properties, improving the efficacy of the medicine?

Lacto-Fermented Vegetables

As is common in many other regions of Eastern Europe, a few cultivated vegetables are pickled in a brine solution (salted water, usually 5–8%) and

lacto-fermented among the Gorani. The percentage of salt in the brine solution used is critical to fostering an environment in which only the halophilic (salt-loving) organisms can thrive and less-desired microbes (including fungi which destroy the product) are diminished or killed. However, at higher salt concentrations (>15%), LAB will not grow well. In addition to the brine solution, factors such as the autochthonous microbial flora associated with the plants used, the solution pH and level of oxygen exposure all play critical roles in determining which microbes will dominate the fermentation process, and thus impact the flavor and chemical makeup of the final product (Kabak and Dobson 2011).

The most common fermented vegetables used by the Gorani communities included in this study are green tomatoes (immature fruits which are harvested at the beginning of the fall) and cabbage. Likewise, as is typical in the western Balkans, green (sweet or slightly hot) peppers are fermented in yoghurt ricotta (*urda*). While very common among northern Slavs and related diasporas, the tradition of drinking the brine solution following lacto-fermentation of pickled vegetables as a health beverage or, especially, to recover from a state of drunkenness (Pieroni and Gray 2008), does not seem to be relevant among the Gorani. This is probably best explained by the religious taboos against consumption of large amounts of alcoholic beverages among Muslim Slavs in the Balkans, which is not a factor among Christian Slavs.

Kiselo Mleko, Mečenica, Urda: Lacto-Fermented Dairy Products

Like many other Balkan groups, the Gorani regularly prepare and consume lacto-fermented dairy products, such as yoghurt (*kiselo mleko*), buttermilk (*mečenica*), and yoghurt ricotta (*urda*) in every household. Participants reported that in the past, the starter culture that was added to fresh (boiled) cow and sheep milk was from the microbiota found in nettle roots (*Urtica dioica* L.) or beech tree bark (*Fagus sylvatica* L.), while today, leftover yoghurt or buttermilk are more typically used. The yoghurt can be then "beaten" to produce buttermilk (*mečenica*) and yoghurt butter (*maslo*), which is the butter normally preferred in the southern Balkan pastoralist cuisine (instead of the butter obtained by processing milk cream/*kajmak*). Buttermilk is then heated and stirred to obtain yoghurt ricotta (*urda*). While butter and yoghurt ricotta are widely consumed fresh or in many traditional culinary preparations (especially in pies), yoghurt and buttermilk are drunk and considered to be very good for treating stomachaches and digestive troubles or diarrhea.

Conclusions

Household fermentation practices still play an important role in the human diet in many parts of the world because of its low cost applications for increasing shelf-life of products, and ability to enhance both the nutritional character and sensory qualities of foods. In this case study, we have demonstrated the integral roles that traditional knowledge of local ecological resources and food processing techniques play with regard to the daily maintenance of health and nutrition among the Gorani people of northeastern

Albania. In addition to the health benefits of regular ingestion of fermented foodstuffs, the fermentation tradition also has economic importance as it reduces waste and spoilage of local edible resources and contributes to food security and food sovereignty, especially during the winter months, which are characterized by long periods of isolation due to heavy snows. The practice of household fermentation has either direct or indirect implications for each of the four dimensions of food security (Figure 2) as it can have an impact on food availability (waste foods can be salvaged for consumption), access (local wild resources can be detoxified and modified into nutritious foodstuffs), utilization (potable beverages can be created), and stability (shelf-life of homemade foods can be increased for use during periods of seasonal food insecurity).

In future studies, ethnobiologists who study local knowledge concerning traditional ecological resources should not only consider the role of larger biota (plants and animals) or whole ecosystems, but also that of the *invisible* biota (microbes, especially yeast and fungi) within the foodscape of the *biocultural refugia*. *Biocultural refugia* can be used to describe “places that not only shelter species, but also carry knowledge and experiences about practical management of biodiversity and ecosystem services” (Barthel et al. 2013:1143). The dynamic conservation of these refugia is of crucial importance for preserving the complex system of ethnoecologies, agro-pastoral lifeways, local resource gathering practices, traditional technological and culinary processes, and the *sociabilities* annexed to them, which for centuries have safeguarded healthy and culturally meaningful local nutritional systems for local communities all over the world. Especially in a region like the Balkans, biocultural refugia could represent the focal point not only for the survival of local populations and their biocultural heritage, but also for sustainable, small-scale eco-touristic initiatives.

Lastly, it is important to note that it would be most beneficial to pair future research on TEK concerning ethnozymology with assessments of the actual microbiota involved as they relate to changes in the phytochemistry and bioactivity of the resulting foodstuffs. Studies concerning the use of richly biodiverse compositions of microbiota in ethnozymological processes are highly relevant to the future production of nutraceuticals and medicines with greater health benefits than those created via use of only a limited number of allochthonous species (such as in current commercial practice). Thus, ethnozymology as a field holds promise not only for issues concerning biocultural conservation initiatives, rural development efforts and food security, but also for applications to the creation of healthy food products for a wider public good.

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