Traditional Chestnut Cultivar Quality Assessment as a Tool for Food-Tourism Development in Tuscany Apennine Mountain Area

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Abstract: Consumer appreciation of typical food is a critical success factor for food tourism. Presently tourism shows an increasing interest in connecting geographical location and food, and a renewed interest in traditional chestnut varieties has been recently reported. A study on quality of local chestnuts was carried out in Ortignano Raggiolo (Arezzo), a mountain area of the Apennine Mountains, between Tuscany and Emilia-Romagna Regions, having a very old tradition of chestnut cultivation. Chestnut ecotypes of the area (Perelle, Raggiolane, Selvatiche, Pistolesi, Mondistolle, Tigolesi and Marroni), were collected and subjected to studies on quality. Sensory evaluation, performed on boiled fruits, was determined on the basis of attributes such as peelability, firmness, sweetness, sourness, flouriness, pastiness, astringency and aroma. An expert panel defined different profiles for the tested chestnuts and selected those having the highest eating quality. Pistolesi was the most appreciated variety because of the easy peelability, good firmness, high sweetness, and low astringency, sourness and flouriness. Raggiolane had the best evaluation in terms of aroma and pastiness, and a high level of sweetness. Also Tigolesi had a very positive evaluation by judges. Further evaluations were performed comparing the flour of Pistolesi, Raggiolane, Tigolesi and a kind of commercially available chestnut flour. A typical chestnut-based traditional cake, named "Castagnaccio", was prepared. Flours from typical production area produced very high quality cakes, while the cake obtained from commercial flour had a poorer evaluation for most sensory traits. Chemical analysis revealed for chestnuts of the Ortignano Raggiolo area high nutritional values in terms of carbohydrates, proteins, starch and fibre, and an elevated content of potassium. The cultivars studied contained low concentrations of saturated fatty acids, and high of the healthier unsaturated fatty acids. Sensory profiles and nutritional traits could help the characterization and promotion of local chestnuts as a tool to increase tourism interest and affection for the territory.

Key words: Chestnut, sensory analysis, food quality, food tourism, organic acids, carbohydrates.

1. Introduction

It is a widely held belief that food in tourism is a well known "attraction" [1], and can also become a cultural reference point, an element of regional development and a tourist resource [2]. Local food and foods with a traditional character or image are often perceived by consumers as higher quality [3, 4]. European chestnut (*Castanea sativa* Mill.), cultivated both for fruit and timber, is important for its

socioeconomic and cultural value and for its contribution to the landscape and environment. Chestnut tree occupies almost 10% of the Italian forested surface and has been from ancient times a major source of food for rural populations in mountain regions [5]. Italy possesses a rich source of germplasm [6], and the tree has a very old tradition of cultivation in several areas of the Apennine Mountains between Tuscany and Emilia-Romagna Regions. Small mountain towns, whose economy has been historically based on chestnut production, have maintained ancient genotypes and traditional recipes of typical specialties. Product attributes generated by regional

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characteristics of the manufacturing area or by the use of traditional production practices are considered as tools for creating new opportunities for marketers [7]. A renewed interest in traditional chestnut varieties because of the increasing market for traditional products with a high value and superior quality as attributed by the consumers, has been reported [8]. Researches on quality traits of traditional chestnuts ecotypes can provide opportunities for the support of local production, based on historical and cultural heritage and oriented to build up food tourism by improving place attachment [9]. A study about sensory quality of traditional chestnuts can be of help in orienting a production able to satisfy consumers and to communicate correctly product quality to tourists. Usually varieties are known with the name of the production site, since the product combines typical traits deriving both from genetics and environment. It has been demonstrated that a well known producing region or a place-related name often provides meaningful information about the quality or characteristics of a good [10]. Moreover a geographical indication helps to protect the production from imitation and increases the level of recognition in the global market enhancing local economy [11]. The familiar association between geographical origin and typical food can be a useful tool for increasing touristic appeal, if supported by recognized high quality standards. Origin information, intrinsic properties (e.g., nutritional value) and sensory traits can be conveniently explored as tools to be combined for communicating typical food quality [12]. Chestnuts have been studied as related to quality and sensory traits [10, 13-16]. This research analyzed chestnuts produced in Ortignano Raggiolo, to define ecotype attributes, with the aim of developing high quality products to be used as tools of touristic promotion of the place.

2. Materials and Methods

Chestnuts were collected in the area of Ortignano

Raggiolo (Arezzo), about 40 km South East of Florence, on the base of cultivar local denomination and of phenotypical differences. Ten different ecotypes were subjected to sensory evaluation: Perelle, Selvatiche, Mondistolle, Tigolesi, Pistolesi, Raggiolane and Marroni (the last three harvested in two different sites: A and B). Sensory evaluation was performed on boiled fruits, determining sensory attributes such as peelability, firmness, sweetness, sourness, flouriness, pastiness, astringency and aroma. A trained panel composed of 12 judges evaluated sensory traits of the different cultivars. Boiled fruits were presented, with a random three digit code, to the panellist on a plate. Each attribute was assessed on a scale from 1 (non noticeable) to 9 (extremely intense) [17]. Assessors were request to indicate the overall quality of each sample on a scale from 1 (low quality) to 9 (very high quality).

Further evaluations were performed on a local specialty, a cake made with chestnut flour ("Castagnaccio") obtained from the three ecotypes recording the highest quality evaluations: Pistolesi_B, Raggiolane_A, and Tigolesi. A traditional cake locally named "Castagnaccio" was prepared with chestnut flour, according to a traditional recipe. The same recipe was used to prepare "Castagnaccio" using a kind of commercial chestnut flour. Chemical analyses were also performed on Pistolesi_B, Raggiolane_A, and Tigolesi to determine nutritional values in terms of proteins, lipids, starch and fibre, minerals, sugars and organic acids. Data were statistically analyzed with SAS version 9.1 (SAS Institute, Cary, NC, USA).

3. Results and Discussion

3.1 Sensory Evaluation of Chestnut Ecotypes

Assessors were able to define different profiles for the tested chestnuts. The three ecotypes evaluated as having the highest quality (degree of liking) were Pistolesi_B, Raggiolane_A, and Tigolesi (Fig. 1). Pistolesi_B was the most appreciated variety because of the easy peelability, good firmness, high sweetness,

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and low astringency, sourness and flouriness. Raggiolane_A had the best evaluation in terms of aroma and pastiness, and a high level of sweetness (Fig. 2). Tigolesi recorded lower levels of aroma and pastiness. Assessors identified in boiled chestnut, beside its typical aroma, notes of wood, grass and honey.
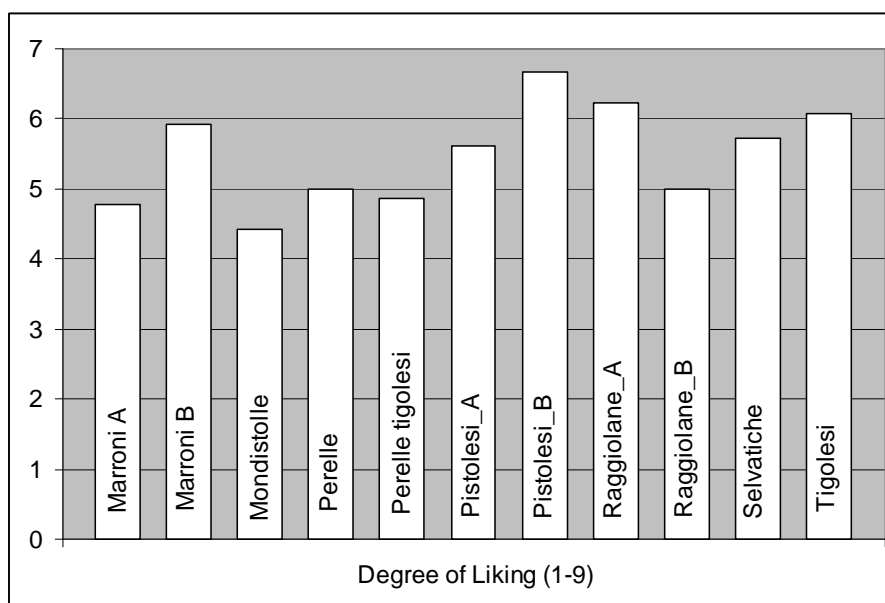

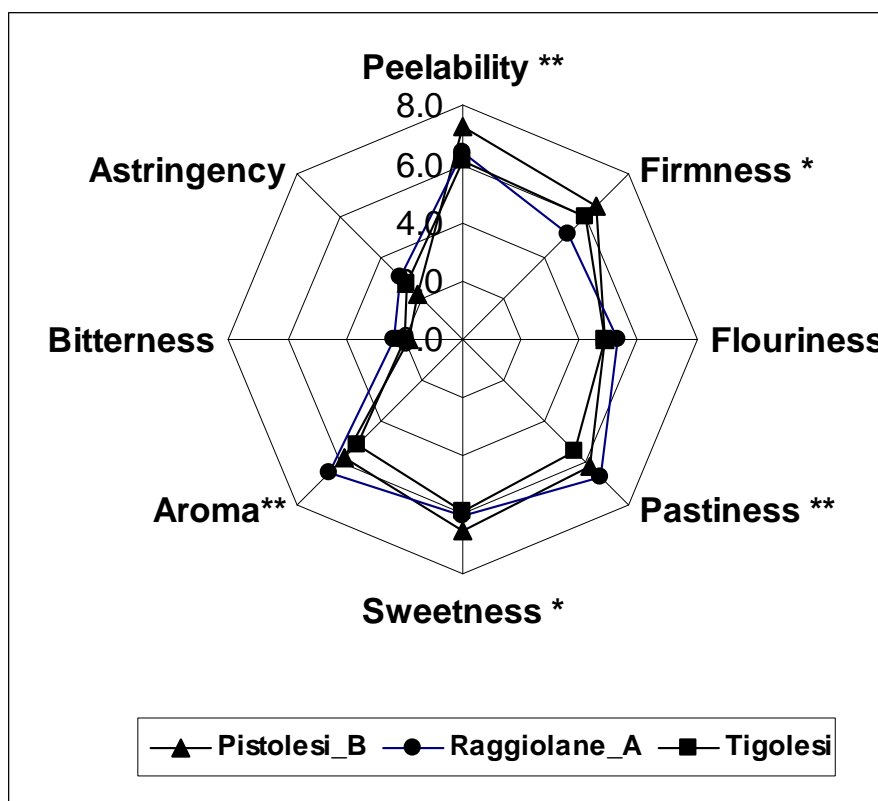**Fig. 1   Overall judgement of chestnut ecotypes.**

Fig. 2   Sensory profilers of boiled chestnut of the ecotypes Pistolesi_B, Raggiolane_A, and Tigolesi.

** Indicates that for the attribute significant differences, at $P < 0.01$, were found, * at $P < 0.05$.

3.2 Sensory Evaluation of Chestnut Cake

Chestnut cake "Castagnaccio", obtained from the three chestnut ecotypes of Ortignano Raggiolo area had sensory traits consistently higher in terms of sweetness and aroma. At the same time negative traits such as bitterness and astringency were of lower intensity as compared to the product obtained from the commercial flour (Fig. 3). These results indicate how from local chestnut flours are obtained high quality products. Among food made with local chestnut flour, no differences were recorded for flavour, but Raggiolane_A had the higher softness and the lower bitterness.

3.3 Biochemical Analyses

Analysis revealed high nutritional values in terms of proteins, lipids, starch and fibre and elevated content of potassium, carbohydrates. In terms of sugar content, sucrose was the main sugar detected in the flour of the analyzed chestnut cultivars (in average 27% of dry weight), fructose and glucose were also present in small percentage (0.75% fructose and 1.06% glucose), while other sugars were less than 0.5% percentage (Table 1). The prevalence of sucrose is in agreement with the results reported by other authors in Swiss, Italian [15] and Portoguese [18] chestnut cultivars.

Flours had about 5% proteins, a good presence of fibre (about 3%) (Table 2). Chestnut confirmed to be a good source of potassium (4%). Small differences were found among tested ecotypes.

As related to fatty acid composition the C18:1 oleic (45%) and C18:2 linoleic (36%) resulted the most represented, with the saturated fatty acid C:16 palmitic (16-16%) at lower concentrations. Among the other five fatty acids detected, only C18:3 linolenic (2%) recorded significant concentrations (Table 3).

Fatty acid composition appeared very similar among tested ecotypes, showing similarities among these products of the territory, according to previuos studies about environmental effects on chestnut composition [13]. The cultivars analyzed contained
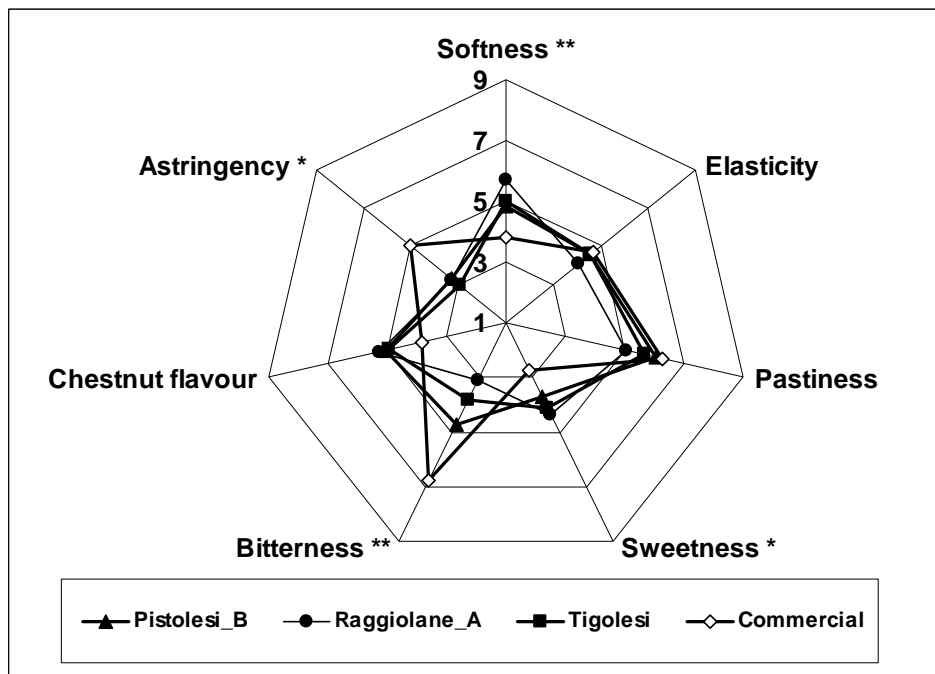

Fig. 3 Sensory profilers of "Castagnaccio" prepared with flour of the ecotypes Pistolesi_B, Raggiolane_A, Tigolesi and with a commercial flour.

** Indicates that for the attribute significant differences at *P* < 0.01, * at *P* < 0.05.

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Table 1   Organic acid and carbohydrates composition of Ortignano Raggiolo chestnuts, percent of flour dry weight.

Cultivar	Succinic acid (%)	Malic acid (%)	Quinic acid (%)	Sucrose (%)	Fructose (%)	Sorbitol (%)	Glucose (%)	Inositol (%)	Raffinose (%)
Pistolesi_B	0.144	0.372	0.205	27.6	0.673	0.117	0.921	0.136	0.417
Raggiolane_A	0.140	0.373	0.227	27.2	0.856	0.092	1.239	0.111	0.279
Tigolesi	0.147	0.372	0.208	28.4	0.705	0.111	1.011	0.117	0.347

Table 2   Moisture, ash, proteins, lipids, fibre and mineral elements composition of Ortignano Raggiolo chestnuts.

Cultivar	Moisture (%)	Ash (%)	Proteins (%)	Lipids (%)	Starch (%)	Fibre (%)	Ca (g/kg)	P (g/kg)	Mg (g/kg)	K (g/kg)
Pistolesi_B	4.83	2.44	5.31	4.25	45,7	3.09	0.53	1.24	0.74	9.90
Raggiolane_A	5.85	2.51	5.54	4.24	46.7	2.95	0.33	1.26	0.74	10.11
Tigolesi	4.95	2.52	5.42	4.25	48.7	3.10	0.52	1.22	0.77	9.58

Table 3   Fatty acid composition of Ortignano Raggiolo chestnuts.

Cultivar	Palmitic (%)	Palmitoleic (%)	Stearic (%)	Oleic (%)	Linoleic (%)	Linolenic (%)	Arachidic (%)	Eicosenoic (%)
Pistolesi_B	15.1	0.08	0.24	45.4	36.5	1.9	0.12	0.41
Raggiolane_A	16.5	0.10	0.17	44.6	36.2	2.1	0.06	0.16
Tigolesi	15.1	0.09	0.21	45.4	36.7	2.1	0.07	0.13

low concentrations of saturated fatty acids, and higher of unsaturated fatty acids, having healthier properties.

4. Conclusion

Trips to touristic places are motivated not only by the expectations created by natural and artistic attractions, scenic environments or specific events, but also driven by the desire of tasting typical local food. Some areas, such as Ortignano Raggiolo have surprising natural beauties, in the middle of an uncontaminated mountain region. However, often this is not enough to provide touristic interest and inspire a time-consuming journey. The development of high quality local food products, based on ancient germplasm and traditional recipes, may be a critical success factors for increasing food tourism. Sensory and instrumental analyses conducted on chestnuts and chestnut based products from Ortignano Raggiolo evidenced the high quality of the product. A capable communication can help in enhancing the touristic appeal of the area, through the offer of typical food of antique origin, supported by the guarantee of up-to-date research aimed to consumer satisfaction. Moreover, cultivation of local raw materials and ingredients, which are mostly used in the production of traditional foods, contributes to provide an imagination on genuineness, appealing for lovers of natural foods. Sensory sciences are able to select attributes which can be perceived and appreciated by consumers. Chestnut products from Ortignano Raggiolo exhibited interesting quality traits; consumer tests could confirm the potential appreciation of these typical products and stimulate the person-to-person communication, still a major tool of touristic advice.

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