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Linking producers' and consumers' perceptions in the valorisation of non-timber forest products: An analysis of Ogiek forest honey

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ABSTRACT

This work aims to present a multidisciplinary approach that combines methodologies from economic anthropology and sensory science to valorise non-timber forest products; this is performed by using Kenyan forest honey as a case study to foster a positive alignment between producers and consumers living in the target market. Firstly, ethnographic research was carried out in Kenya to analyse the core competences of the forest honey producers (n = 20) and to select honey samples for the sensory evaluation. Secondly, a consumer test was performed in Italy to investigate the perception of the sensory properties by using a rate-all-that-apply test and its hedonic responses for six forest honeys by subjects living in Italy (n = 50).

Based on the producers' perceptions of the definition of the harvesting area and the floral origin of the honeys, an indigenous classification was outlined. The key core competences of the producers centred around the traditional method of production. The harvesting area was determinant in the preference of the interviewees, being forest honeys produced from the nectar of indigenous melliferous species, from which originate the most appreciated products. Similarly, results from the consumer test showed that harvesting area and the floral origin influenced the hedonic response. Moreover, the drivers of liking (e.g. intense colour, clear appearance, smoked flavour) and disliking (e.g., granularity, opaque appearance) were identified.

The paper suggests a development trajectory that promotes the commercial potential of local production but preserves the heritage thereof. The approach is potentially applicable to all marginalised food products and facilitates a promising prospective for sustainable development.

1. Introduction

It is well established that forest ecosystems contribute to the livelihoods of the rural and indigenous communities in developing countries (Mahonya, Shackleton, & Schreckenberg, 2019). Despite the importance of forest ecosystems as a resource, we are witnessing a dramatic decrease in forest areas worldwide. This trend is connected to the ways in which forest ecosystems have been used and managed (van Noordwijk et al., 2014). A different approach began in the 1980s (Freese, 1997; Evans, 1993), based on the recognition of the value and the role of the diversity of non-timber forest products (NTFPs) (Jacobs, 1984; de Beer & McDermott, 1989).

NTFPs are deeply rooted in rural food, socio-cultural, and economic systems, playing a crucial role both for subsistence uses and economic profit (Angelsen et al., 2014; Rowland, Ickowitz, Powell, Nasi, & Sunderland, 2016; Shackleton, Ticktin, & Cunningham, 2018; Wahlén, 2017). NTFPs support the livelihoods and fostering the food security of rural dwellers, especially during economic and environmental crises (Sunderlin et al., 2005; Liswanti, Sheil, Basuki, Padmanaba, & Mulcahy, 2011; Wunder, Börner, Shively, & Wyman, 2014). NTFPs have also pointed out their role in promoting local development (Shackleton, Campbell, Lotz-Sisitka, & Shackleton, 2008; Babulo et al., 2009; Vira, Wildburger, & Mansourian, 2015). The harvest and management of NTFPs is largely carried out by local communities that use practices and methods related to their traditional knowledge and heritage (Neumann & Hirsch, 2000). These activities are often driven by ethical and moral principles that favour the sustainable use of natural resources (Stiles, 1994; Sills, Shanley, Paumgarten, de Beer, & Pierce, 2011).

The potential of NTFPs have prompted several international organisations to support the commercialisation of these products. However, these initiatives have not always achieved the expected results (Arnold & Pérez, 2001; Kusters, Achdiawan, Belcher, & Ruiz Perez, 2006; Roe et al., 2015). The main difficulty found is in reaching an adequate balance between the economic sustainability of the enterprise and the

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social, cultural, and environmental conservation of the local reality (Vandebroek, Reyes-García, de Albuquerque, Bussmann, & Pieroni, 2011). The introduction of NTFPs in national and international market circuits have led to a "cultural commodification" (Zulkifli & Ridwan, 2019) of the products that led to a change in the use of the environment and a loss in cultural and biological diversity (Matias, Tambo, Stellmacher, Borgemeister, & von Wehrden, 2018). In order to prevent such critical issues, NTFP commercialisation projects should aim to ensure fair access to forest resources, share economic benefits, along with other benefits among the different stakeholders, and promoting cultural and social values related to these products (Shackleton, Delang, & Angelsen, 2011; Kar & Jacobson, 2012; Coomes, Takasaki, Abizaid, & Arroyo-Mora, 2016).

In Africa, more than two-thirds of the population depend on the use of forest resources (Sunderland, Harrison, and Ndoye, 2004; CIFOR, 2005, Kaimowitz, 2003, Sunderlin et al., 2005), and several studies have identified the diverse products, uses, and knowledge linked to NTFPs (van Dijk & Wiersum, 1999; Monela, Kajembe, Kaoneka, & Kowero, 2001; Ndam & Marcelin, 2004; Shackleton & Shackleton, 2004; Powell, Hall, & Johns, 2011). Recently, there has been growing interest in these products in the cooperation and development fields, and a wide range of African forest products have acquired value due to their vital alimentary, ecological, and socio-cultural role, in addition to their economic potential both within national and international markets (Shepherd, Kazoora, & Müller, 2013).

In East Africa, honey is one of the most crucial NTFPs, serving as a central product for projects that aim to bring together the continent's socioeconomic and environmental goals (Anand & Sisay, 2011; FAO, 2011). Traditional forest beekeeping is an important source of livelihood and income in this context (Ingram & Njikeu, 2011; Mwakalukwa, 2016), having a considerable economic value in the local market. Moreover it has recently gained commercial interest in the international market as well (Lowore & Bradbear, 2015; Lowore, Meaton, & Wood, 2018). Forest beekeeping is also a sustainable activity that does not harm local resources; indeed, its intensification can contribute to the conservation and strengthening of local biodiversity (Bradbear, 2009).

In Kenya, honey trade and consumption are strictly tied to the economies of rural regions, with traditional beekeeping being the most common production method (Nightingale & Crane, 1983; Muli, Munguti, & Raina, 2007; Carroll & Kinsella, 2013). This activity plays a fundamental role for communities living close to major forested areas such as Mt. Elgon, Mt. Kenya, and Mau Forest, as well as arid and semi-arid regions (Shiluli et al., 2012). While the promotion of beekeeping has been a central element in the several national and international rural development (Government of Kenya, 2013), little attention has been paid to traditional beekeeping and to the promotion of forest honey. Few attempts have been made to expand the international market for forest honey by adopting differentiation strategies that can be effective both in identifying the interests of international consumers and in contributing to the promotion of the local environmental and cultural heritage (Musinguzi, Bosselmann, & Pouliot, 2018).

In order to convert forest honey into a resource for improving the livelihoods of local communities and promoting local tangible and intangible resources, it is crucial to design alternative strategies that can synergistically connect profitability and economic development with environmental and socio-cultural sustainability. This is to avoid conventional strategies of market promotion based on the intensification of production leading to both the depletion of the local environment and a profound transformation in the culture of the communities (Koot, Hitchcock, & Gressier, 2019; Comaroff & Comaroff, 2009); this is due to most products being transformed in order to please consumers and the environment being altered according to the needs of production (Oberholtzer, 1995).

This work aimed to present a multidisciplinary approach as an innovative tool for the valorisation of NTFPs using Kenyan forest honey as a case study, in order to foster a positive alignment between the producers' core competences, which are the resources, knowledge and capabilities that constitute the strategic advantages of a business (Prahalad & Hamel, 1990), and the insight of customers living in the target market. In particular, the research aimed at offering a potential differentiation strategy for the honey produced by the Ogiek people in the Mau Forest and helping the local beekeepers in expanding and improving the export of honey on the Italian market, that is already a target market for the product (D'Alessandro, 2018).

2. Materials and methods

The experimental plan included two phases. Part one of the research ethnographically analysed the core competences of the honey producers, conducting fieldwork in Kenya. The ethnographic method is a widely employed qualitative social research methods that that encompasses the use of observation, in-depth interviews and focus group (Borneman & Hammoudi, 2009; Ellen, 1984; Hannes & Lockwood, 2012; Van Maanen, 2011). Data were analysed accordingly the epistemic tradition in economic anthropology (Hann & Hart, 2011), which is the branch of cultural anthropology that studies the cultural aspects connected with production, distribution and consumption of goods. Fieldwork data were analysed exploring the relationship. Particular attention was given to the analysis of the values associated by producers to honey and its production. This fieldwork also included the selection of the samples of local honey used in the second phase. The second step focused on the sensory perception and preferences of Western consumers for the selected honeys.

The entire study complies with the Declaration of Helsinki for Medical Research involving Human Subjects and was approved by the Ethics Committee of the University of Gastronomic Sciences. Both producers and consumers were informed about the general aim of the study and the data collection procedures. All subjects voluntarily joined the study and provided their informed consent.

2.1. Ethnographic analysis of producers' perception of value

2.1.1. Study area and the community

The Eastern Mau forest, situated in the Rift Valley of Kenya, is part of the largest remaining closed-canopy montane forest ecosystem in East Africa and the most important water catchment areas in Kenya (Nkako, Lambrechts, Gachanja, & Woodley, 2005; Were, Dick, & Singh, 2013). Since at least the 19th century, the area has been inhabited by the Ogiek, a hunter-gatherer group of forest dwellers belonging to the Nilotic ethnic mosaic (Huntingford, 1929; Sang, 2001). In the past, the Ogiek depended heavily on the forest for subsistence and shelter (Blackburn, 1974; Ngece, 2003), however, in the last century, due to the socioeconomic, political, and environmental changes, they have adopted a small-scale farming and livestock subsistence strategy (Huntingford, 1951; Kratz, 1980; Kimaiyo, 2004). Despite the change, honey still represents an important NTFP, being at the centre of the Ogiek economic, social, cultural, and religious life (Micheli, 2014a).

The research was conducted specifically in the Mariashoni District (Molo Sub County, 1800–3000 m a.s.l., approximately 273,300 ha, 9,000 inhabitants; Micheli, 2014b) due to the relevance of the development initiatives involving the Ogiek people in the area hinging on honey production. In 2012, Ogiek beekeeper communities joined the Mariashoni Community Development Community-Based Organization (MACODEV CBO) (Manitese, 2019; Necofa, 2019); this is an umbrella body, which brings together twelve self-help groups of local beekeepers living both in the Eastern Escarpment of the Mau Forest and near it, aiming to conserve the remaining indigenous forest from disruption by preserving and promoting forest honey production and the Ogiek cultural heritage.

2.1.2. Fieldwork method

Data collection aimed to define the factors that influence the

perception of value (Graeber, 2001) and motivate individuals' consumption, as well as the production specialisation. In doing so, the research investigated the indigenous model of the categorisation of honey in terms of sensory profiles, harvesting areas, production techniques, floral composition, and perception of value. Based on the findings, the samples of local honey used in the second phase were selected.

Fieldwork was conducted ethnographically, and data collection was completed through in-depth interviews (20 semi-structured in-depth interviews were conducted with beekeepers belonging to eight different MACODEV CBO self-help groups), focus groups (four focus groups with 16 representatives of the senior management of the MACODEV CBO and the executives of international NGOs supporting the local initiative), and observation of the production site (conducted in the apiaries, honey-processing plant, training centre for beekeepers, and local shops). Interviewees were selected in collaboration with MACODEV CBO in order to be representative of the local producers' population in terms of age, gender, residence, and involvement in the honey sector.

Interviews were conducted in Swahili and Kikuyu by two local research assistants fluent in Swahili, Kikuyu, and English, and in English by the researchers; they lasted approximately 60 min each. The interviews investigated the different kinds of honey traditionally gathered in the area, their indigenous names, floral composition, methods of production, and sensory perception in respect of their appearance, taste, flavour, and texture. Information concerning beekeeping techniques and tools and socio-cultural and ecological practices related to the different honey typologies were also investigated, as well as the characteristics that drive informants' preferences for the products. The focus groups, conducted in Swahili and Kikuyu, investigated the economic and entrepreneurial structure of local honey production, the push and pull factors that characterise the market, and the economic and social history of production in the Mau forest. Interviews and focus groups were recorded and transcribed into English.

2.2. Honey sensory evaluation by Italian and foreigners consumers

2.2.1. Focus group

A preliminary focus group was conducted with six Italian subjects (five females, age: 20–33 years) to select the sensory attributes used in the consumer test. During a 90-minute session, the participants tasted six Ogiek honey samples and generated a list of appropriate attributes to describe them. After a collective discussion, from an initial list of 58 generated terms (some of which included hedonic terms, or not clear attributes or terms with an overlapping meaning), examiners did an accurate vocabulary selection which ended up with 28 selected descriptors: five for appearance (amber/orange colour, clear, chestnut brown/caramel colour, opaque, straw yellow/golden colour), five for taste (bitter, salty, sour, sweet, umami), 14 for flavour (animal/wild, balsamic, bark/wood, caramel, chamomile, citrus/grapefruit, fermented, floral, hay/dry leaves, molasses, pungent, smoked, soy sauce, vegetable/fresh grass), and four for texture/mouthfeel (astringent, grainy, liquid, solid).

2.2.2. Consumer test

Fifty adults (70% Italians; 46% males; age range: 20–57 years; mean: 31) were recruited among the staff and students of the University of Gastronomic Sciences (Pollenzo, Italy). Subjects were asked to not eat, drink, smoke, or wear perfume for one hour before the evaluation session. The consumer session included a liking test, a rate-all-that-apply (RATA) test, and a questionnaire. For the sensory tests, the honey samples (15 g) were presented in hermetically sealed disposable plastic containers (96 ml), codified with three-digit random codes, in a randomised and balanced order, and at room temperature (20 ± 1 °C). Firstly, participants were asked to rate the sample's appearance, taste, flavour, texture, and overall liking on a 9-point hedonic scale (1 = dislike extremely, 9 = like extremely; Peryam & Pilgrim, 1957). Secondly, during the RATA test, participants were asked to select from the list of 28 attributes all that they perceived in each sample. For each selected attribute, they were required to evaluate the perceived intensity on a generalised Labelled Magnitude Scale (gLMS) (0 = no sensation; 100 = the strongest imaginable sensation of any kind) (Bartoshuk et al., 2004). Prior to tasting, subjects were instructed in the use of the gLMS scale. "The strongest imaginable sensation of any kind" was defined as the most intense sensation that involves remembered/imagined sensations in any sensory modality, including nonoral sensations, such as loudness, oral pain/irritation, or sight (e.g. the loudest sound ever heard, the most intense pain experienced, or the brightest light ever seen) (Piochi et al., 2019; Piochi, Cabrino, Morini, & Torri, 2020). Between samples, a rinsing procedure was implemented. The questionnaire aimed to collect information on age, gender, nationality, and frequency of consumption of honey (less than once a month; once a month; 2–3 times a month; 1–3 times a week; 4–7 times a week or more). Participants took approximately 25–30 min to complete their tasks. Data were collected with the Fizz version 2.47B (Biosystèmes, Couternon, France) software in individual booths under a white light.

2.3. Data analysis

2.3.1. Qualitative data from producers

The interview and focus group transcripts were entered into NVivo qualitative data analysis version 12.5.0 (QSR International, Melbourne, Australia), and codes, concepts, and categories were generated during the analysis (Wainwright & Russell, 2010). Data were analysed using a quality content analysis (Elo et al., 2014) aimed at identifying the key factors of the value perception and the criteria of valorisation. The results were combined in order to complete an explanatory model of indigenous value recognition linked to honey and beekeeping. The model visualises the hierarchy of value underlying producers' preferences.

2.3.2. Quantitative data from consumers

Liking data for each sensory modality were submitted to a two-way analysis of variance (ANOVA) mixed models (fixed factor: product; random factor: subjects) to estimate the effect of the product on average appreciation, followed by the Tukey comparison test of averages ($p < 0.05$). From the RATA test, two data matrices were obtained: 1) occurrences matrix, with the number of choices of each descriptor by all subjects for each product; 2) intensity matrix, with the sum of the intensity scores by all subjects for each attribute for each product. A Penalty Analysis was conducted on liking data and the occurrences matrix of sensory attributes to assess which sensory attributes positively or negatively affected the liking of the six products considered together.

The occurrences matrix was analysed with Cochran's Q test followed by a comparison test for multiple pairs, namely McNemar (Bonferroni) to test whether products differed significantly in the occurrences of their descriptors. The intensity matrix was exposed to a two-way mixed ANOVA model (random effect: subject; fixed effect: sample) to assess whether the sample significantly affects the perceived intensity of the sensations. An external preference map was obtained by applying Partial Least Regression (PLS) to explore the relationship between the overall liking of all participants (Y data set) and the perceived intensities of the attributes evaluated in the RATA test, for which the two-way ANOVA highlighted a significant effect of the product (X data set).

2.3.3. Relating data from producers and consumers

The data emerging from the analysis conducted in the two phases of the study has been cross analysed, following the qualitative model of alignment proposed by Gibson (2015), in order to highlight the convergence between producers' core competencies and consumers' insights in value recognition. The model is based on a combined analysis of the most important and recent transformations of the consumption trends (discontinuity analysis) and the main assumption that drives

Table 1
Honey sample description.

Sample code	Floral origin			Honey type	Harvesting area	Process*	Notes
	Local name	Scientific name	Indigenous (I)/Exotic (E)				
DOMBEYA	Mukeo/Dombeya	*Dombeya goetzenii* K.Schum.	I	Monofloral, Indigenous	Upper Forest	Raw honey	
NYAECK	Nyaeck	*Carduus schimperi* Sch.Bip. *Trifolium burchellianum* Ser. *Oxalis corniculata* L. *Alchemilla* L.	I	Multifloral, Indigenous	Upper Forest	Raw honey	Different plants and shrubs
MULTIFLORAL I	Maraisit, Simbeywet, Tongotwet	*Allophylus abyssinicus (Hochst.) Radlk.* *Scutia myrtina* (Burm.f.) Kurz *Ilex mitis* (L.) Radlk.	I I I	Multifloral, Indigenous	Central Forest	Raw honey	
MULTIFLORAL I + E	Blue gum/Eucaliptus, Mukeo/Dombeya, Maraisit, Nyaeck	*Eucalyptus* spp. *Dombeya goetzenii* K.Schum *Olea capensis* L. *Carduus schimperi* Sch.Bip. *Trifolium burchellianum* Ser. *Oxalis corniculata* L. *Alchemilla* L.	E I I I	Multifloral, Indigenous + Exotic	Lower Forest	Raw honey	
BLEND I	Mukeo/Dombeya Nyaeck Maraisit, Simbeywet, Tongotwet	*Dombeya goetzenii* K.Schum. *Carduus schimperi* Sch.Bip. *Trifolium burchellianum* Ser. *Oxalis corniculata* L. *Alchemilla* L. *Allophylus abyssinicus (Hochst.) Radlk.* *Scutia myrtina* (Burm.f.) Kurz *Ilex mitis* (L.) Radlk.	I I I I I	Blend, Indigenous	Upper Forest + Central Forest	Refined honey	Blend of samples Dombeya, Nyaeck, and Multifoloral I
BLEND I + E	Mukeo/Dombeya Nyaeck Blue gum/Eucaliptus, Maraisit,	*Dombeya goetzenii* K.Schum. *Carduus schimperi* Sch.Bip. *Trifolium burchellianum* Ser. *Oxalis corniculata* L. *Alchemilla* L. *Eucalyptus* spp. *Allophylus abyssinicus (Hochst.) Radlk.*	I I E I	Blend, Indigenous + Exotic	Upper Forest + Lower Forest	Refined honey	Blend of samples Dombeya, Nyaeck, and Multifoloral I + E

* Raw: neither sieved nor refined. Refined: sieved and refined.

production and consumption practices (orthodoxies analysis), the patent and latent needs of the consumers (customer's insight analysis), and the core competences of the producers useful in responding to the different needs of the consumers (core competence analysis).

3. Results

3.1. The main factors affecting beekeeping organisations and honey production

The ethnographic research aimed to understand the main features of honey production areas, identifying the most relevant elements concerning the methods, tools, and techniques adopted by local producers, and assessing to what extent they impact the local value system classification. The ethnographic research highlighted the heterogeneity of beekeeping activities in the area. The main distinguishing elements were the production methods, harvesting techniques, pedoclimatic conditions of the production areas, and the nectar composition of the honeys.

Local beekeepers identified three different harvesting areas: Lower Forest, Central Forest, and Upper Forest. These were the three main ecological zones in which beekeeping activity is carried out. The producers highlighted different features in the floral composition and the climatic conditions in the three zones. In particular, there was a progressive reduction of indigenous melliferous species, moving from the upper part of the ecosystem to the production areas located in the lower part of the forest. Although in the Upper Forest and to a lesser extent in the Central Forest beekeeping was favoured by the presence of native plants and shrubs, in the Lower Forest the native forest coverage decreased, being replaced by secondary forest where exotic trees and plots of land cultivated with tubers and cereals prevailed. In the Central and Uppper parts of the forest, the most representative sources of nectar mentioned by the informants were *mukeo*, *tongotwet*, *maraisit,* and *nyaeck*. These are tall trees (*mukeo* and *tongotwet*) and shrubby species such as the *maraisit*. Local informants defined *nyaeck* as a type of honey produced by the nectar of various flowers whose flowering occurs about a month after the end of the rainy season. On the other hand, in the Lower Forest, the most widespread melliferous species were eucalyptus, maize, and potato plants.

According to producers, weather and temperature affected the choice of beekeeping methods. In particular, in the Central and Upper parts of the forest, beekeepers still adopted traditional practices, with the log-hive the most widespread means of production. This is a traditional hive made from large cylinders of East African cedar (*Juniperus procera* Hochst. ex Endl.), known locally as *torokuet*. Log-hives are hung on the branches of trees approximately 5–10 m above the ground. Before placing the hive, it is covered with various layers of bark that isolate the hive and increase its inner temperature, thus promoting colonisation and bee activity. Harvesting was carried out by climbing the tree and cutting the comb from the hive. Before the harvest, the hives were smoked with lichens found in the forest, known locally as *kurongurik* (*Usnea* Hill), to calm down the bees. In the Lower Forest, modern beekeeping practices prevailed, with Kenyan Top Bar (KTB) and Langstroth being the most common hive methods. Harvesting was carried out using modern tools, including a smoker gun fuelled with dry leaves. Unlike the traditional method of harvesting, honey extraction required less smoke.

3.2. Honey value classification system

The informants classified honey based on three main characteristics: the floral composition, the harvesting area, and the processing methods.

Concerning the botanical origin, informants distinguished honeys in two categories: honeys that include nectar only from indigenous plants (e.g. *mukeo, nyaeck, tongotwet*), which are the ones most appreciated, and honey whose floral origin included nectar from exotic species (e.g. eucalyptus, maize, potatoes).

Crucial in the value classification is the harvesting area, recognising the greatest value to honey harvested in the Upper zones and the lowest to products produced in the Lower Forest. This is related to the floral characteristics of the areas that see the strongest presence of indigenous species concentrated in the Upper zones.

Finally, informants distinguished between raw honey (not sieved nor refined), which is mostly appreciated by the Ogiek, and processed honey, which is sieved and refined in order to reach the standards for commercialisation. This category includes the products currently sold by the MACODEV CBO cooperative, which are honey-blends from different harvesting areas.

3.3. Sample selection and characteristics

According to the aforementioned classification, six samples of four of the most representative categories were identified and selected (Table 1).

All of the informants noted a link between the sensory characteristics of honey, their preferences, harvesting area, and floral composition of the samples. On the other hand, there was no consistency on the impact of the production system on the sensory profile of the products and their appreciation.

Regarding nectar composition, there was a preference for honeys from indigenous species such as *mukeo* (DOMBEYA), *tongotwet* (MULTIFLORAL I + E), *maraisit* (MULTIFLORAL I), and *nyaeck* (NYAECK). In particular, 14 informants specified *mukeo* honey as the most frequently consumed indigenous honey. This is a whitish honey with a sweet taste, harvested before the flowering of the other bee forage species; for this reason, beekeepers consider it to be monofloral honey. The sweet taste was also perceived as the distinguishing property of *nyaeck* and *tongotwet* honeys, while for other products a bitter aftertaste prevailed. On the other hand, there was no consistent relation between the other sensory characteristics of the samples (i.e. flavour and texture) and the preferences of the respondents.

Forest honeys (DOMBEYA, NYAECK, MULTIFLORAL I) were also valued based on their different alimentary and medicinal uses. The preferences of the interviewees were affected by the final use of the product since honeys with a bitter taste were mainly used for medicinal and ritual purposes. For instance, *maraisit* honey was considered to be one of the most suitable products for the preparation of *rotinik*, a fermented beverage consumed during circumcision and bride wealth ceremonies.

The preference for forest honeys was also linked to socio-cultural factors and the positive impact of beekeeping on the forest. In particular, respondents associated forest honeys with Ogiek's cultural heritage and livelihood. In this sense, the production and consumption of honey was thought to enhance the sense of belonging to the community and beekeepers' identity.

According to the interviewees, forest honey was identified as a pure and natural product since it was not contaminated by sources of pollution (e.g. pesticides and chemicals used in cultivated plots such as in the Lower forest). Moreover, it was valued due to its composition of nectar of indigenous species, giving it better nutritional and medicinal properties. For instance, informants attributed more significant healing properties to multifloral honeys (NYAECK and MULTIFLORAL I).

Furthermore, honey and traditional beekeeping were considered by the interviewees to be crucial in safeguarding the forest ecosystem. Beekeeping was perceived as a way to control the forest, thus limiting activities that could produce a negative impact on the ecosystem (e.g. wood cutting, charcoal production). According to the informants, an increase in the number of log hives would inhibit the cutting of trees and, in so doing, would help to preserve the natural resources and improve the production of honey both for home consumption and the market.

For Lower Forest honey (MULTIFLORAL I + E), respondents

Table 2
Results of the two-way mixed ANOVA models (fixed factor: product; random factor: subjects; model without interactions) in estimating the effect of the product on the liking of different sensory modalities (appearance, odour, taste, flavour, mouthfeel, overall liking) considering the ratings given by 50 subjects. Mean values sharing at least one superscript letter in columns indicate no significant differences ($p < 0.05$) from the Tukey (HSD) comparison test, while 'ns' indicates not significant differences.

Sample code	Appearance	Odour	Taste	Flavour	Texture	Overall
DOMBEYA	**5.2^{b}**	5.1^{ns}	**4.9^{c}**	**4.8^{b}**	**4.7^{b}**	**4.8^{b}**
NYAECK	**6.6^{a}**	5.3^{ns}	**5.9^{ab}**	**5.9^{a}**	**6.9^{a}**	**6.1^{a}**
MULTIFLORAL I	**6.7^{a}**	5.2^{ns}	**5.7^{abc}**	**5.6^{ab}**	**6.5^{a}**	**5.7^{ab}**
MULTIFLORAL I + E	**5.0^{a}**	5.0^{ns}	**5.0^{bc}**	**5.1^{ab}**	**4.7^{b}**	**5.1^{b}**
BLEND I	**6.6^{a}**	5.1^{ns}	**6.0^{a}**	**5.8^{ab}**	**6.7^{a}**	**6.1^{a}**
BLEND I + E	**5.2^{b}**	4.8^{ns}	**5.2^{abc}**	**5.2^{ab}**	**5.1^{b}**	**5.2^{b}**
F	15.701	1.041	4.496	3.999	19.138	6.288
p	< 0.0001	0.394	0.001	0.002	< 0.0001	< 0.0001

showed a lower preference for the sensory properties of the product, as taste and flavour were the least appreciated aspects. In particular, the presence of non-native species' nectar in the product was highlighted as a factor that negatively affected the liking of the respondents. For instance (although not present in the samples), beekeepers believed that maize blossoms give honey an unpleasant smell. In general, honeys whose floral composition included exotic melliferous species were perceived as less valuable in terms of their sensory, nutritional, and medicinal properties.

Even for refined honeys (BLEND I and BLEND I + E), the sensory profile of the sample negatively impacted the preference of the respondents. In particular, most of the beekeepers argued that honey refinement affected the taste of the product and reduced its healing properties (BLEND I). However, the consumption of refined honeys was limited among the respondents and often associated with modern food practices.

3.4. Honey perception by Italian and foreigners consumers

3.4.1. Consumers' acceptability

The results from the two-way ANOVA models (Table 2) illustrate a significant effect of the product ($p < 0.001$) on liking for all considered sensory modalities, except for odour. NYAECK, MULTIFLORAL I, and BLEND I were ranked as the most liked honeys overall, likely due to the significantly high acceptability observed for their appearance and texture. By contrast, DOMBEYA, MULTIFLORAL I + E, and BLEND I + E were the least liked honey by consumers.

3.4.2. Sensory properties

The effects of both the botanical source and the geographical origin have been shown to affect the sensory properties of honeys (Castro-Vázquez, Díaz-Maroto, de Torres, & Pérez-Coello, 2010). From Cochran's Q and the Bonferroni's tests, the sample had an effect only for 11 attributes (reported in bold in Table 3). The differences mostly concerned the appearance and texture (chestnut brown/caramel colour, straw yellow/golden colour, clear, opaque, grainy, liquid, solid). The NYAECK, MULTIFLORAL I and BLEND I samples had comparable occurrences for the liquid, clear, and chestnut brown/caramel colour, umami and soy sauce flavour attributes. On the contrary, DOMBEYA, MULTIFLORAL I + E, and BLEND I + E were more frequently described as grainy, opaque, and having a chamomile flavour.

3.4.3. Drivers of preference

From the Penalty Analysis conducted on the attribute occurrences matrix and overall liking data, a Penalty chart for the totality of the samples was obtained (Fig. 1). The X-axis shows the percentage of subjects who chose the attributes over the six samples and the Y-axis the impact of the attributes on liking (whether positive or negative). The more an attribute had a high percentage and a high mean impact (positioned in the upper right quadrant), the more its positive influence on liking. Instead, if an attribute had a negative mean impact value its presence in the sample (perception of that sensation) was negative for the liking. Based on these criteria, grainy texture, opaque appearance and pale (amber/orange, straw yellow/golden) colour had a general negative impact on honey liking, while the attributes able to increase the affective response were a liquid texture, clear appearance, intense chestnut brown/caramel colour, sweet taste, and smoked flavour.

The external preference map (Fig. 2) obtained by applying a PLS to the intensity ratings of the 18 significant RATA attributes from the two-way mixed ANOVA model more comprehensively depicts the relationship between the overall liking and the intensity of the sensory attributes perceived in each sample by the consumers during the RATA test.

Most consumers are distributed on the negative quadrants of the first axis, showing a preference for honeys with a chestnut brown/caramel colour and clear appearance, a liquid texture, an intense salty and umami taste, and with strong caramel, soy sauce, and smoked flavours (NYAECK, MULTIFLORAL I, and BLEND I). Additionally, a lower preference was observed for the most solid and grainy samples associated with an opaque appearance, and a more intense chamomile and citrus/grape fruit flavour (MULTIFLORAL I + E, BLEND I + E). By contrast, the hay/dry leaves and floral flavours were mainly associated with the DOMBEYA honey, which was the least preferred, indicating that these attributes perceived at high intensities acted as drivers of dislike. A very high intensity of sweet taste was a negative driver of dislike for most consumers, despite the choice of this attribute ranking as generally positive in the Penalty analysis.

3.5. Producers – Consumers alignment

The results of the review, analysis, coding, and clustering of the data from the empirical and desk research, according to the model of Gibson (2015), is shown in Fig. 3. In particular, the analysis focused on the trends of perception, experience, and the areas of potential production development for MACODEV CBO. A literature review informed the identification of the main discontinuities of the market concerning traditional and exotic products in Western markets, as well as the market's orthodoxies. A sensorial analysis defined the customers' insight, while an ethnographic analysis of the community is key in defining the producers' core competences.

4. Discussion

The research aimed to facilitate producers in the implementation of the innovation process by setting their ideals and values with the preferences expressed by new customers. In so doing, the analysis aimed to reduce the process of commodification of traditional production commonly recorded in cases of economic intensification and internationalisation (Comaroff & Comaroff, 2009) by preserving the local hierarchy of value linked to production and relating and contextualising the needs of a foreign market within it.

Table 3
Sensory results depicting for each attribute: the Cochran's Q test p value (p CQ), the occurrences (OC) obtained from the RATA test, and the significance values from the multiple comparison tests (McNemar; Bonferroni) (B). In the rows, B values sharing at least one superscript letter indicate no significant differences ($p < 0.05$) while 'ns' indicates not significant differences.

Attributes	p	DOMBEYA			NYAECK			MULTIFLORAL I			MULTIFLORAL I + E			BLEND I			BLEND I + E		
	CQ	OC	B		OC	B		OC	B		OC	B		OC	B		OC	B	
Amber/orange colour	0.006	17	0.340	ns	21	0.420	ns	16	0.320	ns	25	0.500	ns	22	0.440	ns	32	0.640	ns
Animal/wild flavour	0.076	12	0.240	ns	20	0.400	ns	14	0.280	ns	10	0.200	ns	18	0.360	ns	13	0.260	ns
Astringent	0.115	9	0.180	ns	16	0.320	ns	11	0.220	ns	11	0.220	ns	13	0.260	ns	8	0.160	ns
Balsamic flavour	0.203	10	0.200	ns	10	0.200	ns	11	0.220	ns	14	0.280	ns	10	0.200	ns	5	0.100	ns
Bark/wood flavour	0.781	11	0.220	ns	9	0.180	ns	13	0.260	ns	11	0.220	ns	14	0.280	ns	12	0.240	ns
Bitter	0.181	16	0.320	ns	23	0.460	ns	18	0.360	ns	14	0.280	ns	16	0.320	ns	15	0.300	ns
Caramel flavour	0.018	9	0.180	ns	18	0.360	ns	18	0.360	ns	7	0.140	ns	14	0.280	ns	11	0.220	ns
Chamomile	**0.000**	**21**	**0.420**	**c**	**14**	**0.280**	**abc**	**4**	**0.080**	**a**	**15**	**0.300**	**bc**	**6**	**0.120**	**ab**	**17**	**0.340**	**bc**
Chestnut brown/caramel colour	**0.000**	**4**	**0.080**	**a**	**36**	**0.720**	**b**	**38**	**0.760**	**b**	**11**	**0.220**	**a**	**32**	**0.640**	**b**	**9**	**0.180**	**a**
Citrus/grapefruit flavour	0.047	7	0.140	ns	5	0.100	ns	6	0.120	ns	13	0.260	ns	5	0.100	ns	9	0.180	ns
Clear	**0.000**	**15**	**0.300**	**a**	**31**	**0.620**	**b**	**29**	**0.580**	**b**	**7**	**0.140**	**a**	**36**	**0.720**	**b**	**11**	**0.220**	**a**
Fermented flavour	0.216	6	0.120	ns	10	0.200	ns	12	0.240	ns	9	0.180	ns	7	0.140	ns	9	0.180	ns
Floral flavour	0.060	19	0.380	ns	11	0.220	ns	15	0.300	ns	19	0.380	ns	10	0.200	ns	14	0.280	ns
Grainy	**0.000**	**40**	**0.800**	**b**	**7**	**0.140**	**a**	**8**	**0.160**	**a**	**46**	**0.920**	**b**	**7**	**0.140**	**a**	**48**	**0.960**	**b**
Hay/dry leaves flavour	0.065	12	0.240	ns	7	0.140	ns	6	0.120	ns	9	0.180	ns	11	0.220	ns	16	0.320	ns
Liquid	**0.000**	**35**	**0.700**	**bc**	**39**	**0.780**	**c**	**42**	**0.840**	**c**	**7**	**0.140**	**a**	**39**	**0.780**	**c**	**23**	**0.460**	**b**
Molasses flavour	0.039	8	0.160	ns	20	0.400	ns	18	0.360	ns	13	0.260	ns	15	0.300	ns	15	0.300	ns
Opaque	**0.000**	**25**	**0.500**	**bc**	**11**	**0.220**	**ab**	**8**	**0.160**	**a**	**30**	**0.600**	**c**	**7**	**0.140**	**a**	**31**	**0.620**	**c**
Pungent	0.408	9	0.180	ns	8	0.160	ns	14	0.280	ns	10	0.200	ns	8	0.160	ns	9	0.180	ns
Salty	0.242	9	0.180	ns	16	0.320	ns	18	0.360	ns	13	0.260	ns	15	0.300	ns	14	0.280	ns
Smoked flavour	**0.000**	**24**	**0.480**	**a**	**34**	**0.680**	**ab**	**26**	**0.520**	**a**	**22**	**0.440**	**a**	**39**	**0.780**	**b**	**33**	**0.660**	**ab**
Solid	**0.000**	**5**	**0.100**	**a**	**10**	**0.200**	**a**	**6**	**0.120**	**a**	**41**	**0.820**	**b**	**4**	**0.080**	**a**	**13**	**0.260**	**a**
Sour	0.783	16	0.320	ns	13	0.260	ns	16	0.320	ns	16	0.320	ns	13	0.260	ns	13	0.260	ns
Soy sauce flavour	**0.000**	**5**	**0.100**	**a**	**14**	**0.280**	**abc**	**25**	**0.500**	**c**	**6**	**0.120**	**a**	**22**	**0.440**	**bc**	**11**	**0.220**	**ab**
Straw yellow/golden colour	**0.000**	**33**	**0.660**	**d**	**5**	**0.100**	**ab**	**4**	**0.080**	**a**	**21**	**0.420**	**cd**	**4**	**0.080**	**a**	**16**	**0.320**	**bc**
Sweet	0.115	37	0.740	ns	30	0.600	ns	27	0.540	ns	32	0.640	ns	32	0.640	ns	35	0.700	ns
Umami	**0.000**	**10**	**0.200**	**a**	**22**	**0.440**	**b**	**20**	**0.400**	**ab**	**14**	**0.280**	**ab**	**22**	**0.440**	**b**	**9**	**0.180**	**a**
Vegetable/fresh grass	0.176	7	0.140	ns	6	0.120	ns	5	0.100	ns	10	0.200	ns	3	0.060	ns	6	0.120	ns

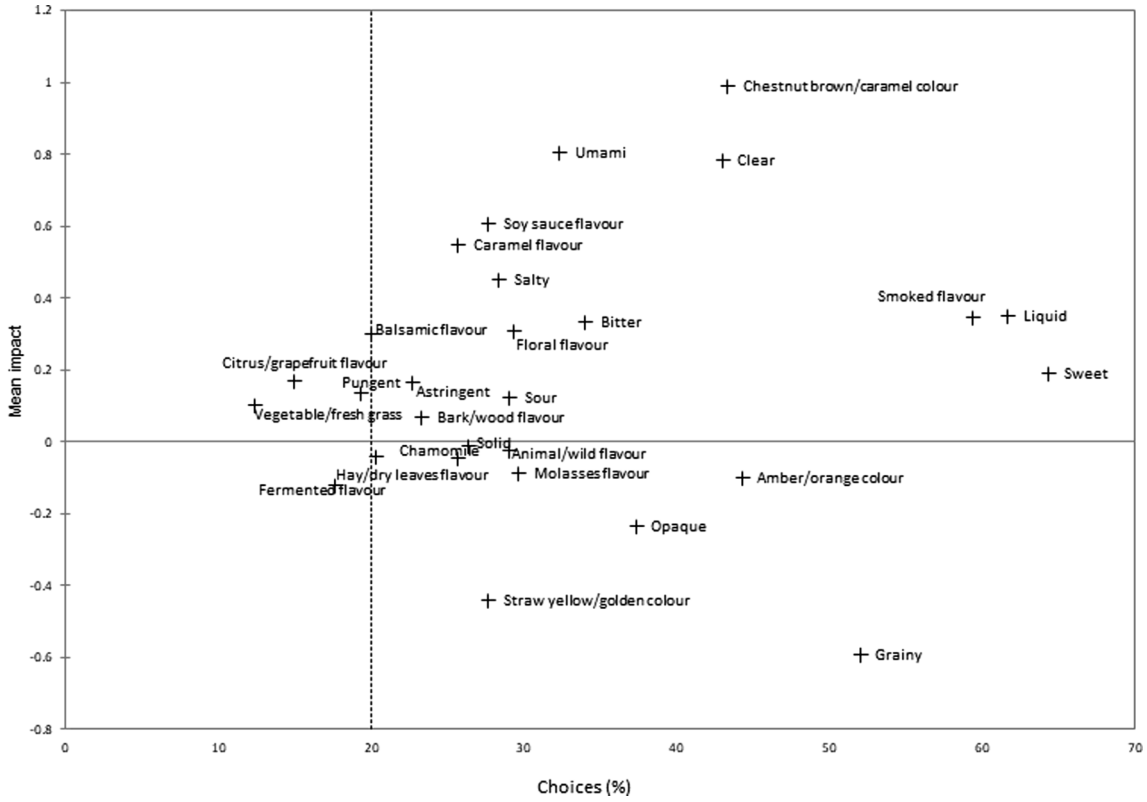

Fig. 1. Penalty analysis chart obtained from the liking data and occurrences of the RATA test performed on six honeys by 50 consumers. The threshold percentage of the population over which the results are considered to be significant is displayed with a dotted line.

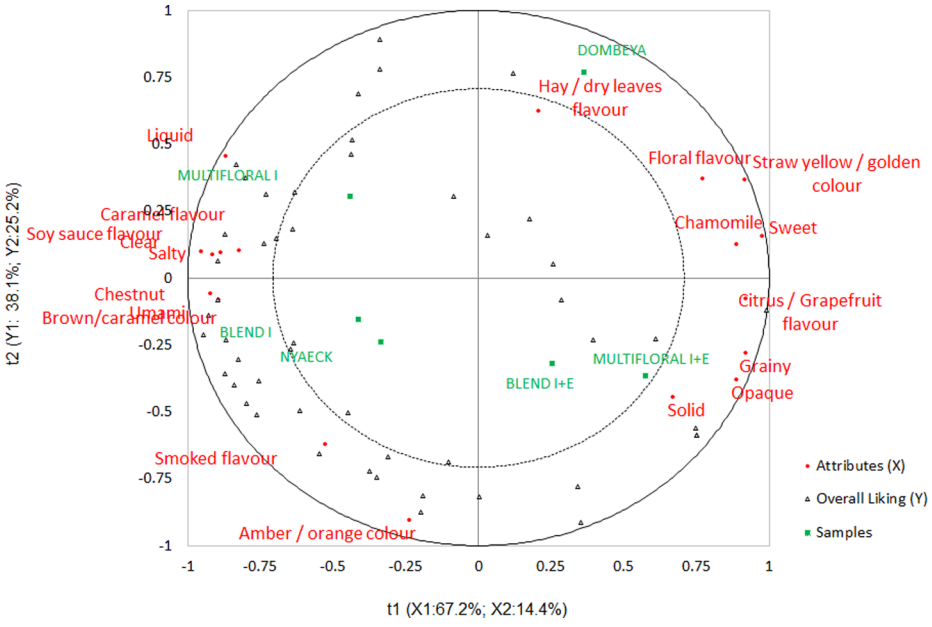

Fig. 2. External preference map of six honeys obtained considering the 18 significant sensory attributes in the two-way ANOVA applied to the intensity RATA values provided by 50 consumers. Triangles represent consumers based on their liking (Y dataset), circles represent the significant sensory attributes (X dataset), and squares represent the honey samples.

The results of the research suggest a path forward in the development of Ogiek honey. The present Western market was developed on the basis of four discontinuities that have occurred in the past 20 years: a growing interest for exotic and traditional food productions (Barham, 2003); increasing attention towards healthy, organic, and natural food products; increasing attention towards the aspects of socioeconomic and environmental sustainability (Lairon, 2012; Pinna, 2016); and a growing demand for traceability and information on the origin of products (Barham & Sylvander, 2011). Ogiek honey and its production relate to all these issues.

Considering the honey market, and more general non-Western foods imported into the Western market, a common orthodoxy is the assumption that a product must adhere to international standards and have similar physical and sensory characteristics to what is already in the market and liked by consumers (Lotti, 2010; Grasseni, 2011). From this perspective, one could expect the strong smoky flavour of Ogiek honey to be a major handicap (Azuma, 2009). However, the analysis of consumers' insights in the sensory evaluation demonstrated that this feature fascinated consumers. The emerging customer insights highlighted the appreciation for the 'smoked flavour' (number of occurrences ≥ 22), which clearly relies on the peculiar smoking phase applied before the harvest in which the hives are smoked with natural moss found in the forest to calm down the bees. Moreover, the customers appreciated the complexity of the taste of the multifloral honey

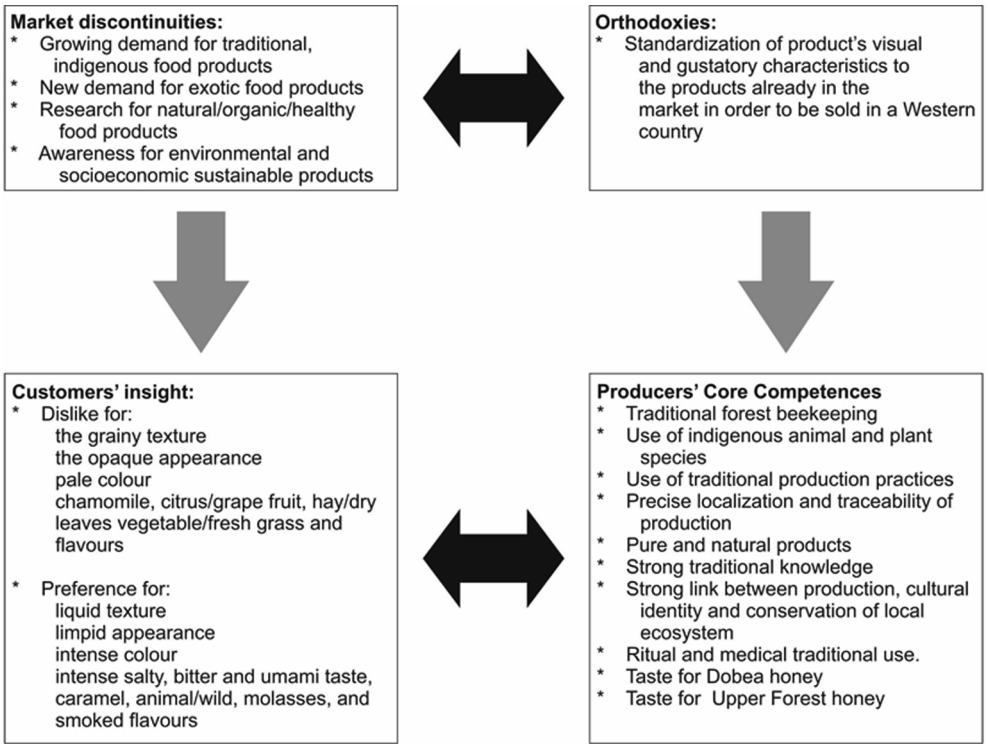

Fig. 3. The main elements concerning market discontinuities, orthodoxies, consumer insights, producers' core competences, and their interconnection.

produced in the Upper Forest. The heterogeneity in floral composition, climatic conditions, and processing techniques of the Ogiek honeys translated into a richness in sensory profiles. In fact, the sensory evaluation by Italian and foreigners consumers highlighted an impressively high number of sensory descriptors associated with the honeys, which were generated during the focus groups (n = 58) and selected for the RATA test (n = 28). In particular, the 'chestnut brown/caramel colour', 'clear', and 'liquid' attributes were positive drivers of liking, while the 'solid', 'opaque', and 'grainy' attributes combined with a 'straw yellow/golden colour' were negative drivers of liking. Consequently, the current study confirmed that colour and textural attributes are relevant attributes in honey for consumer liking, as previously observed (González-Viñas, Moya, & Cabezudo, 2003). In particular, the clear preference for honey with a chestnut brown/caramel colour is in agreement with a previous study reporting that in Germany, Austria, and Switzerland, dark honeydew honeys are especially appreciated (Bogdanov, Ruoff, & Persano Oddo, 2004). Moreover, the results of the present work agree with Murphy, Cowan, Henchion, and O'Reilly (2000), who revealed that Irish consumers preferred honeys with a dark golden colour over samples with a light golden colour. On the other hand, the distribution of the consumers on the preference map showed a higher acceptability of few consumers for honey samples characterised by a straw yellow/golden colour. This result confirms that consumers vary in their colour acceptability, as indicated by Gámbaro, Ares, Giménez, and Pahor (2007), who discovered a cluster of subjects liking intermediate-coloured honeys and another cluster preferring dark reddish honeys.

The presence of peculiar sensory notes such as 'soy sauce flavour' and 'smoked flavour', which are not commonly found in honeys sold in Western markets and thus orthodoxically unacceptable for a Western palate, were not a barrier to liking, since honeys characterised by these sensations were well liked. This suggests that, despite not being informed about the processing operation and the provenance of the products, Western consumers may be able to perceive (and like) peculiar sensory properties that they may not be particularly familiar with. This is in accordance with a recent study that revealed how peculiar notes (e.g. "mushroom", "wet earth", "yeasty", "barnyard") were liked by Finnish consumers in honeys of different botanical origins (Kortesniemi et al., 2018). Moreover, as reported by us, the 'smoky' flavour was also recently identified as characterising honeys from Africa (Deneulin et al., 2018).

Considering customers' insights, the key core competences of the producers are the traditional methods of production based on smoking beehives using traditional techniques, as well as the preference for beekeeping conducted in the Upper Forest, which are deeply embedded in the traditional beekeeping knowledge of the Ogiek community, as is their cultural identity. As previously suggested for Danish honeys, promotion strategies for consumers may be based on the uniqueness of certain sensory properties (Stolzenbach, Byrne, & Bredie, 2011).

Considering the specific tastes of consumers, despite the Ogiek preference for DOMBEYA honey, the indigenous multifloral honeys (NYAECK, MULTIFLORAL I, BLEND I) emerge as the products the local community should aim to export to the West. The development of this product will, on one hand, support the conservation of traditional production methods because they are fundamental in providing the particular composition characterising the preferred honey and, on the other, is tied to a precise environment in need of attention, and so will support forestry conservation in the region, potentially slowing the advancement of the agricultural frontier.

Considering the structure of the study, limitations of the experimental plan relay to two major points: the sample size and the sample representativeness. The number of 50 subjects indeed is small and does not allow for segmentation. However, it is correct and accepted in sensory studies applying affective quantitative methods. In fact, this number is indicated as the minimum requirement by reference updated textbooks (Meilgaard, Civille, & Carr, 2016) and it is widely used even in recent studies (Aguayo-Mendoza et al., 2020; Ares, Baixauli, Sanz, Varela, & Salvador, 2009; Di Monaco, Giacalone, Pepe, Masi, & Cavella, 2014; Kathrine, Ellen, Gunilla, Margrethe, & Bjørg, 2013; Liu, Hannum, & Simons, 2019; Maizura, Aminah, & Wan Aida, 2016; Torrico, Fuentes, Gonzalez Viejo, Ashman, & Dunshea, 2019). The choice of a small sample was also partially due to the fact that the available amount of honey for each sample for the present study was low. Therefore, authors did not have the chance to enlarge the sample size. The use of a convenience sample (majority of students and staff from the University) is a frequent limitation in sensory studies (Di Monaco et al., 2014; Maizura et al., 2016; Nolan, Halperin, & Geliebter, 2010; Torrico et al., 2019) due to the fact that sensory tastings are often held at the Sensory Laboratories.

5. Conclusion

In the present study, we aim at offering a differentiation strategy for the forest produced in the Mau forest and suggesting a path forward in the development of the export of Ogiek honey for the Italian market. Considering the results from the ethnographic fieldwork and the customer's insights, we suggest that indigenous multifloral honeys produced with traditional techniques in the Upper Forest would be the best products for the target market.

This contribution offers an innovative way for the valorisation of NTFPs based on a multidisciplinary approach aimed at limiting the risk of cultural commodification (Spyridakes, 2018). The combination of methodologies from economic anthropology and sensory sciences facilitated the improved design of a strategy to differentiate forest honey according to the local value classification system and the perception of the product in a foreign target market. In calling for more attention to the analysis of local values linked to NTFPs, the paper singles out a direction of development that does not limit the strong commercial potential of a local production method but rather preserves its heritage. Thus, the paper provided an example potentially applicable to all sectors of marginalised food products opening a promising path for sustainable development.

CRediT authorship contribution statement

Dauro Mattia Zocchi: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing - original draft. **Maria Piochi:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing - original draft. **Giorgia Cabrino:** Data curation, Formal analysis, Investigation, Resources, Visualization. **Michele Filippo Fontefrancesco:** Conceptualization, Investigation, Methodology, Validation, Visualization, Writing - original draft, Writing - review & editing. **Luisa Torri:** Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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