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Underutilized Fig (*Ficus carica* L.) Cultivars from Puglia Region, Southeastern Italy, for an Innovative Product: Dried Fig Disks

Giuseppe Ferrara [1,*], Andrea Magarelli [1], Andrea Mazzeo [1], Antonio Coletta [2], Pasquale Crupi [3], Francesco Loperfido [4], Giuseppe Maggi [4] and Pasquale Venerito [5]

1 Department of Soil, Plant and Food Sciences, University of Bari Aldo Moro, Via G. Amendola 165/A, 70126 Bari, Italy; andrea.magarelli@uniba.it (A.M.); andrea.mazzeo@uniba.it (A.M.)
2 CREA, Council for Agricultural Research and Economics, Research Center for Viticulture and Enology, 70010 Turi, Italy; antonio.coletta@crea.gov.it
3 Interdisciplinary Department of Medicine, University of Bari Aldo Moro, 70124 Bari, Italy; pasquale.crupi@uniba.it
4 Foundation ITS Academy Agroalimentare Puglia S.C., 138 Cda Marangi n. 26, 70010 Locorotondo, Italy; lope.francesco@gmail.com (F.L.); g.maggi@itsagroalimentarepuglia.it (G.M.)
5 Centre of Research, Experimentation and Training in Agricultural CRSFA 'Basile Caramia', Via Cisternino 281, 70010 Locorotondo, Italy; pasqualevenerito@crsfa.it
* Correspondence: giuseppe.ferrara@uniba.it; Tel.: +39-(080)-5442979

Abstract: Fig fruits have recently received more attention by consumers for their quality as either fresh or dried fruits and, consequently, growers are becoming more interested in the cultivation of this species. Figs are mainly consumed as processed fruits (dried, marmalade, jam, etc.), but limited attention has been paid to new possible processing applications of several local cultivars grown in Mediterranean countries. This study aimed to investigate both the morpho-pomological characteristics and consumer sensory ratings (two groups: students and technicians) for four fig cultivars processed as a new type of product, 'dried fig disks'. The results showed that three out of the four cultivars (Processotto Nero, Natalese Nera, and Verde di Natale) had good pomological characteristics such as fruit weight and skin color, as well as easy peeling, yield, ripening time, and TSS. The same cultivars received positive hedonic scores for appearance (>5 on a 10-point hedonic scale), flavor (4–6 on a 10-point hedonic scale) and taste (6–7 on a 10-point hedonic scale). The overall score was positive for Processotto Nero, Natalese Nera, and Verde di Natale (>5 on a 10-point hedonic scale), whereas one cultivar, Comunione, was less appreciated (<5 on a 10-point hedonic scale). The flavor–sensory attributes most appreciated were black-red fruit, cooked, grassy, and floral; fig off-flavors were perceived as rancid only by students and to a limited extent. Consumer overall acceptance toward dried fig disks was mainly driven by the acceptability of appearance of the new product, together with pleasant flavor and taste.

Keywords: disks; sensory analysis; dried figs; health benefits; fig processing

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1. Introduction

Ficus carica (Moraceae), commonly known as fig, is one of the more than 750 species of the tree genus *Ficus* [1,2]. It is cultivated widely in the Mediterranean region, where it is reported to have become established ≈ 6000 years ago [3]. The simplicity of fig tree domestication, by cutting and planting part of branches/twigs, and the nutritional role of its edible fruit (mainly dried) in human diet explain the ancient association with horticulture and why its success has preceded that of other fruit trees [4]. Fig as a fresh fruit is very perishable, with a short post-harvest life, i.e., 7–10 days [5], and its availability for extended consumption has been made possible through sun drying since ancient times [6]. The world's biggest producer and exporter of figs, Turkey, contributed 300,000 MT of figs produced in 2019, 84,923 MT of which were exported as dried fruits, for a commercial

value of almost USD 300 million [7]. The production and consumption/export of dried figs is typical of countries with Mediterranean climates, as well as countries such as Iran or Afghanistan, whereas dried figs were imported from several countries at a total of almost 90,000 MT in 2019 [7]. The nutritional composition of fig fruits varies among the cultivars because of the growing conditions (pedo-climatic characteristics), the cultural practices adopted, time of harvest, duration of ripening, etc. [6]. Dried figs possess a high polyphenol concentration when compared with other fruits and are rich in fiber, copper, manganese, magnesium, potassium, calcium, and vitamin K [8]. Dried figs are available on the market, even as further processed fruits, i.e., filled with nuts or covered with chocolate or other ingredients. In addition to being consumed as they are, dried figs can be further processed as concentrated syrup, wine, or vinegar [6].

Sliced dried fruits are available on the market for very popular fruits, such as apple, pineapple, banana, etc. The possibility to process the figs as sliced dried fruits (dried fig disks) could prompt a higher inclination to the consumption of this healthy fruit and consequently to its cultivation. On the other hand, sliced dried figs could also be sold directly as snack products in vending machines in schools, gyms, and stores, and be available to young people as a healthy alternative to junk food. As a sun-dried fruit, it has also been used as fig tea, since the ripe fig fruits are cut into thin slices and put in the boiled water of a cup of tea, providing a relaxing and refreshing effects [9].

Further interests have been focused on its biological activities and the role of fruit drying technologies in the processing industry of fig to preserve these healthy properties. Mechanical and electrical devices (even with solar power) enhance the productivity of drying and improve natural antioxidant compounds, consumer safety, and the final quality of fruits in general [10–12]. Most of the studies in the pharmacological field validate its potential application as a food supplement, not only for healthy diets, but also even for medical usages [8,13].

The key features for figs to be used for drying include: high total soluble solids content (TSS), low acidity values (TA), fleshy skin together with visual appeal, organoleptic characteristics (porosity, texture, rehydration properties, flavor, juiciness, taste, firmness, etc.), chemical properties (water activity, chemical stability, taint, off-flavor, etc.), as well as safety (microbial load, pests and contaminants), which are also the leading quality parameters in other dried fruits [8,14]. However, considering the high relevance of organoleptic characteristics as an essential quality trait of fruit, the human sensory description remains the best approach to evaluate the consumers' preferences and appreciation for such foods [15]. The sensory description requires a process of quantification of personal responses, based on a specific questionnaire and a group of members defined as panelists. It is recommended that at least one group consists of untrained consumers, so that the evaluation can be sufficiently accurate; commonly, children or students represent a potential consumer category for this purpose [16].

The presence of many local cultivars and the possibility of new processing approaches are solid keys to promoting new interest in fig cultivation. The recent data (2022) for Puglia Region (Southeastern Italy) report that the agricultural area dedicated to fig is 500 ha with a harvested amount of 3342 MT, with respect to 1490 ha and 9481 MT reported for Italy [17]; this limited cultivation is due to its low-value crop attraction for the growers. In recent years, several studies have been conducted to investigate the fig rich genetic diversity and counteract germplasm erosion in Puglia Region [18–21]. On these bases, an accurate analysis of germplasm characterization is a useful tool for guiding on-farm conservation and valorization of local fig accessions [22]. Evaluation of threatened accessions can reveal important agronomic and organoleptic characteristics for both economic profitability and consumer acceptance. Moreover, the application of different technologies to the traditional methods of processing could add more value to the final product on the market.

The aim of this study was to evaluate, either pomologically or sensorially, a new processed food (dried fig disks) obtained from local fig cultivars as a marketable novel snack product, in order to obtain a new interest for fig cultivation, appreciation, and consumption

toward more sustainable and healthy horticulture. Figs have been dried as whole fruits for centuries, but to our knowledge, this is the first time that: (a) dried figs are being produced as thin disks to make them more attractive for new and traditional consumers; (b) underutilized fig cultivars are being used for such a purpose; (c) late-ripening and dark-skinned cultivars are being evaluated as dried disks.

2. Materials and Methods

2.1. Fig Materials and Organoleptic Analyses

In Puglia Region, Southeastern Italy, 4 local fig cultivars (Figure 1), identified and described in a previous project, were used for the drying process: 'Verde di Natale', 'Processotto Nero', 'Natalese Nera' and 'Comunione'. These four fig cultivars were chosen because they are defined as 'winter figs', due to the fact that they start ripening from the end of summer (Processotto Nero) almost up to December (Verde di Natale). The wide ripening time could allow for the production of dried figs even during autumn and winter, in order to have a new processed product (fig disks) with different organoleptic characteristics as the season proceeds. Moreover, this could be a chance for the valorization of minor and underutilized fig cultivars, in order to prevent their loss and favor a new edible use as dried figs.

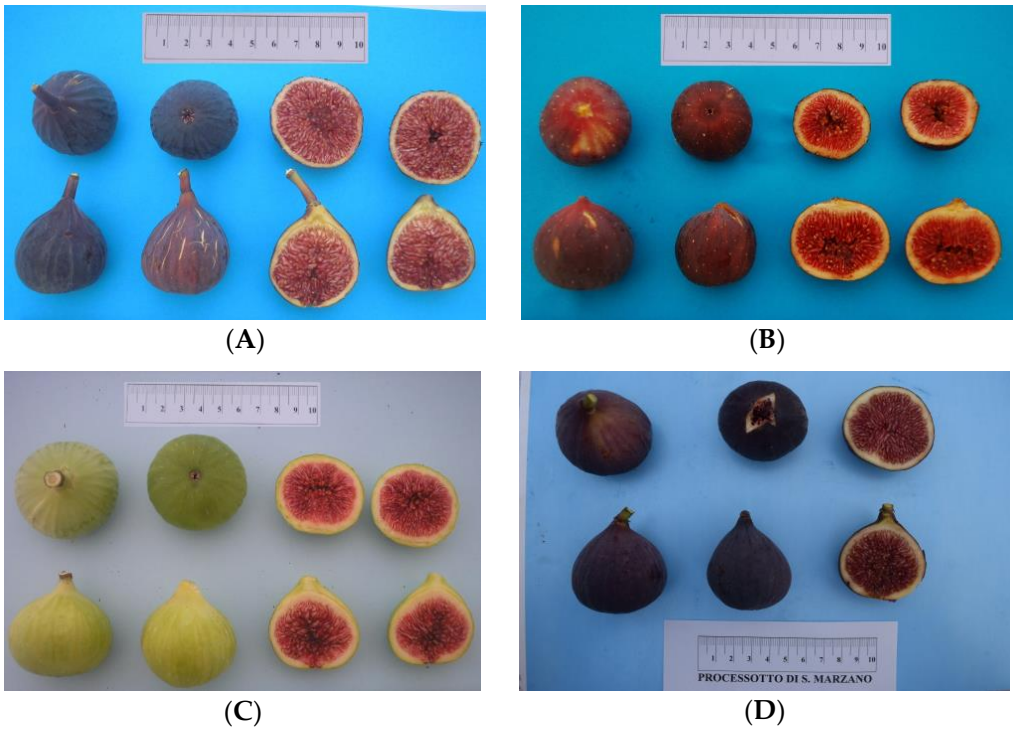

Figure 1. The four cultivars used in the trial: Natalese Nera (**A**), Comunione (**B**), Verde di Natale (**C**), Processotto Nero (**D**).

The characterization of the fruits from the four cultivars was carried out using the IPGRI (International Plant Genetic Resources Institute) descriptors for *Ficus carica* [23].

The fig fruits were collected at the ripening stage (based on color, size, and TSS) to be used for the successive processing activities. In total, 3 replicates of 10 fruits each were used for the determination of: total soluble solids (TSS) using a digital refractometer (model HI 96801, Hanna Instruments, Woonsocket, RI, USA); as well as titratable acidity (TA) and pH using an automated pH-meter (PH-Burette 24, Crison Instruments, Barcelona, Spain).

Before the drying process, fruits were sorted and selected, and fruits with defects (cavities, browning, etc.) were discarded. Fruits to be dried were cleaned of dust and soil particles. The commercial quality standards for the dried fig market are overseen by the United Nations Economic Commission for Europe (UNECE) under their Dry and

Dried Product Standard. Under DPP-14, producers are responsible for ensuring minimum requirements are met before their products are marketed to consumers. These requirements include physical appearance, hygienic condition, and overall texture [8]. The commercial quality standards require that dried figs produced for direct consumption must contain moisture of less than 26% for untreated figs, and 26–40% for high moisture, treated figs. The global market for dried figs is characterized by fruits obtained through the sun drying of fresh or semi-dried (on the tree) figs on trays, mats, or under tunnels [24]. It is obvious that drying parameters such as air temperature, velocity, and relative humidity, as well as duration of the processing, affect the final quality of the dried figs [8].

2.2. The Drying Process

The procedure adopted for drying the figs was adapted in order to obtain a new final product (dried fig disks) with respect to indications by the manufacturer of the dryer [25], calibrated to the whole fruit. It is well known that novelty represents a factor that increases consumer curiosity and could increase the appeal towards a specific category of products ('positive consumer reaction'). The change in the shape and type of presentation of the dried figs and the processing method were conducted in order to preserve and increase the content of the bioactive substances as healthy components and sensory characteristics, now recognized as fundamental drivers for consumer appreciation and choice. The drying process adopted in the trial is described in Figure 2.

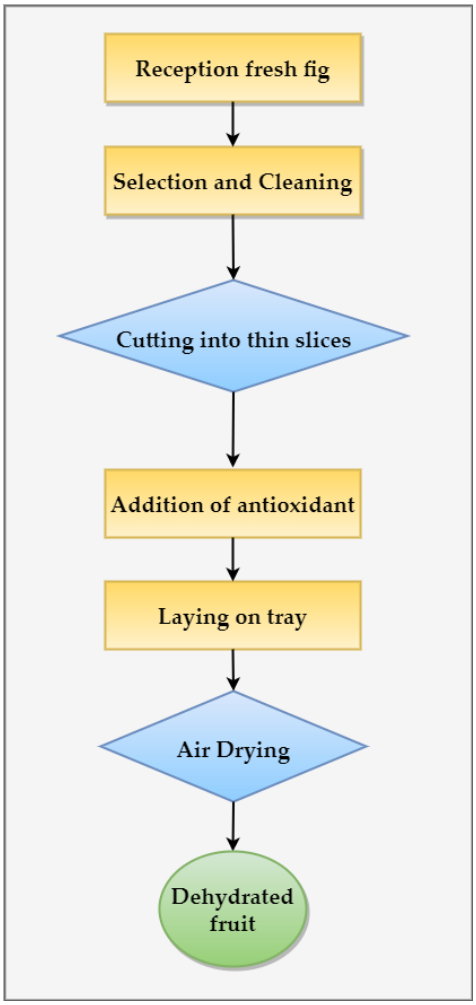

Figure 2. Diagram of the processing activities adopted.

The fig fruits were cut into thin slices, 4–6 mm thick, to allow for very rapid drying. After cutting, the slices were immersed for few minutes in an ascorbic acid bath at a

concentration of 0.3 g/L. Subsequently, the slices were placed on a tray and finally sent through the drying process, which was applied in two steps: (1) for 30 h (after 20 h, the slices were flipped) at 55 °C and (2) for 1.5 h at 68 °C. The final yield of the dried slices was in the range of 16–23%.

2.3. The Experimental Sensory Procedure

Sensory analysis is defined as 'a scientific method used to awaken, measure, analyze, and interpret those responses to products that are the result of perception through the senses of sight, smell, touch, taste, and hearing' (Definition accepted and adopted by the American Society for Testing and Materials and Institute of Food Technologists) [26,27]. In the case of new products that are not habitually consumed and that may be unrelated to usual consumption, in terms of shape, aroma, and taste, the sensory analysis represents a crucial phase to define the degree of acceptability of the food, regardless of whether it has significant nutraceutical characteristics in its composition.

Two random working groups of panelists were involved in the tasting of the fig disks: (1) 20 untrained students from the 4th and 5th classes of 2 schools (Group 1), comprising 14 males and 6 females with an average age of 17 years; and (2) 11 trained technicians involved in the agri-food sector (Group 2), for a total of 31 panelists.

The two sensory analysis panels took place on two distinct days, one for each group. Each panelist was provided with 4 copies of an evaluation card (one for each fig cultivar) and received the samples of the four 'dried fig disks' in disposable white plastic plates coded with one-digit numbers (1, 2, 3, 4).

In order to facilitate the taste and flavor recognition procedure, some specific samples were prepared for sweet, bitter, tannic acid, and cooked reference.

2.4. The Hedonic Scale

For each fig cultivar, the panelist was asked to evaluate sensorial parameters and general liking. The values ranged from 1 to 10 in accordance with a 10-point hedonic scale that was created for this purpose. Although a 9-point hedonic scale is commonly adopted for these studies [28], a 10-point hedonic scale can also be used, since the two scales are not statistically different and there are more evaluation points (10 vs. 9) [29,30].

Important characteristics of the fig disks (texture homogeneity, structure and similarity to fresh fruit) were verified with one single response question and counted as frequencies (%). The evaluation card included multiple choice questions related to aroma and flavor characteristics and quantified again on a 10-point scale. Furthermore, the sensory attribute selection provided an 'other' response, for values not listed or not perfectly appreciated by the panelists.

Overall, there were 21 total measured variables in this sensory evaluation (including the overall acceptability). More detailed information about the used indicators can be found in Table 1.

An important aspect was the similarity/dissimilarity of the dried fig disks to the fresh fruit. The processing of fresh fruits can modify the sensory impact of the product, and the sensory evaluation provides information that can be used for marketing, in order to present the fig disks as a competitive product and alternative to the traditional whole dried figs.

Additionally, age, sex, city of residence, employment of the panelists, the period of the year in which the analysis was conducted, whether or not the panelist was a smoker, and the predisposition to a specific category of flavors are aspects that act as variables in the evaluation test.

For this reason, it was considered useful to develop a graph for age (but also for other characteristics) to be associated with the graphs of the QDA (Quantitative Descriptive Analysis) obtained from panelists' responses for a more correct interpretation of the data.

Table 1. Dried fig disks consumer test design.

Indicator	Value	Score Scale
Intensity Color	1 = low 10 = vivid	1–10 point scale
Intensity Smell Taste	1 = none 10 = strong	
Brightness Color	1 = dull 10 = brilliant	
Persistence Smell Taste	1 = short (1 s) 10 = long (10 or more s)	
Palatability Visual Olfactive Taste	1 = low 10 = high	
Gustatory-Tactile Crispness Juiciness Sapidity Hardness Adhesiveness	1 = low 10 = high	
Overall Impression	1 = dislike extremely 10 = like extremely	
Texture Homogeneity	Visible defects Good	Single response question
Structure	Full body Medium body Fibrous	
Affinity to Fresh Fruit Smell Taste	Fresh fruit smell/taste Other smell/taste	
Aromas	Flowery Black/Red fruit Acidic Cooked Grassy Rancid Other	Multiple response question
Flavours	Flowery Sweet Black/Red fruit Cocked Acidic Bitter Grassy Astringent Fermented Other	

2.5. Statistical Analysis

Data from Groups 1 and 2 were treated as two separate population samples, since each group represents different panelists according to our selection criteria (different types of consumers). A one-way analysis of variance (ANOVA) was performed to examine

the variation in consumer ratings based on sight, flavor, and taste approach among the four cultivars used for the dried fig disks. These multisensory evaluations were the dependent variables, while fig cultivar was the 'factor' in R studio software. The acceptance results were analyzed by Tukey's test at a 5% significance level. The data obtained from taste and flavor were plotted in a radar chart in order to better show the differences among the cultivars for each considered value.

3. Results and Discussion

3.1. Pomological and Fruit Quality Traits of Figs

Comunione was the fig cultivar with the smallest fruits (20–50 g), whereas the other three fig cultivars had similar weights (Table 1), between 50 and 90 g, suitable for the production of fig disks of an appropriate size. The fruit size is an important aspect of fig packaging, transporting, marketing, and consumption of dried figs [31,32]. Processotto Nero and Comunione have globose fruits, whereas Verde di Natale is slightly oblong and Natalese Nera is oblate; only Comunione is a symmetric fruit.

The skin color is predominantly purple, with bluish shades in Processotto Nero and Natalese Nera, and brown in Comunione; Verde di Natale, as the name suggests (verde = green in Italian), has a light green color. A recent paper on Iranian fig cultivars reported yellow as the dominant skin color, but the cultivars examined were predominantly at early ripening [33], whereas in a recent survey of the Puglia fig germplasm, many local cultivars presented a dark color (from red to almost black) [20]. In general, light-colored fruits (yellow–green) suffer significantly more sunburn [34]; however, green-skinned cultivars are commonly used for drying, but cultivars with darker skin could be also used for processing as dried figs, as occurs in other countries as USA (such as California 'Black Mission' figs). Darkening of the product is a concern for white cultivars (yellow–green skin), as it influences the product's appearance, which is the major factor that determines the acceptance level among consumers [8,14]. In the USA, growers use dark cultivars for the production of dried figs, since there are no additional treatments required to prevent darkening. The use of dark-skinned cultivars to produce dried fig disks could be a further advantage, due to avoiding the color-darkening issues typical of the white cultivars. Sugar formation is a result of the crystallization of sugar from inside of the fruit on its external surface, but can be prevented with gentle heat treatment [8], as conducted in this trial, and no sugar formation was observed in our dried fig disks.

Most conventional dryers operate at high air temperatures (>65 °C), which contribute to the product's visual and quality degradation [35]. The skin color of the cultivar is an important aspect that can be affected by both the drying methods and the duration of the process [8,36]. Dark-colored figs have significantly higher total phenolic content and antioxidant capacity with respect to yellow–green figs, and although the drying processes reduced both phenolic content and antioxidant activity, the dark-colored cultivars can keep 15–74% higher antioxidant activity than the yellow–green cultivars after drying [36]. The use of late-ripening fig cultivars with dark skin can add a nutraceutical aspect to the novelty of the product, and this aspect could be highlighted when promoting the new product.

The stalk is generally short in all the cultivars, though a little bit longer in Natalese Nera and Verde di Natale (Table 2). Skin lenticels are small and scarce in Processotto Nero and Comunione, and larger and numerous in the other two cultivars. Drupelets are numerous in all four cultivars and of medium size. The number of drupelets ranged from 24 to 575 in several Iranian cultivars, with great variability among cultivars [33]. With regards to juiciness, only Verde di Natale has a small amount of juice, whereas the others are very juicy. The pulp color is red in all four cultivars (somewhat reflecting the skin color, except for Verde di Natale), ranging from a more orange presentation in Verde di Natale to a darker red in Processotto Nero and Comunione. On the contrary, yellow was the most frequent color (72%) for several Iranian cultivars recently evaluated for dried fig processing [33]. In the case of considering fresh consumption, only Comunione is difficult

to peel, whereas in the other cultivars, the skin is easy to remove for consumption of the pulp, which has an intense flavor in all the cultivars.

Table 2. Pomological traits of the fruits of the four fig cultivars.

Traits	Processotto Nero	Comunione	Natalese Nera	Verde Di Natale
Weight (g)	50–90	20–50	50–90	50–90
Shape	Globose	Globose	Oblate	Oblong
Symmetry	Asymmetric	Symmetric	Asymmetric	Asymmetric
Skin color	Bluish purple	Purple–brown	Bluish purple	Light green
Stalk (length)	Short	Short	Medium	Medium
Lenticels (size/number)	Small/scarce	Small/scarce	Large/numerous	Large/numerous
Skin thickness	Medium	Thin	Medium	Thick
Drupelets (size/number)	Medium/numerous	Medium/medium	Medium/numerous	Medium/numerous
Juiciness	Medium	Medium	High	Scarce
Pulp flavor intensity	Medium	Intense	Intense	Intense
Pulp color	Dark red	Dark red	Red	Orange–red
Skin peeling	Easy	Difficult	Easy	Easy
Pulp texture	Fine	Fine	Coarse	Coarse
Yield	Average	Average	Average	Average
Scalarity of ripening (days)	>20	>20	10–20	>20
Ripening time	End of August	End of September	End of September	October

Ripening occurs around the end of August for only Processotto Nero, whereas the other cultivars are generally ripen later, at the end of September to the beginning of October for Comunione and Natalese Nera, and in October and even later for Verde di Natale.

The ripening of the fruits on the one-year shoot lasts for more than 20 days, with the exception of Natalese Nera, for which the fruits ripen within 10–20 days. The yield of all the cultivars is generally average.

With regards to the chemical traits (Table 3), all of the cultivars had a very high edible portion (94–95%), with Verde di Natale representing the lowest value (91%). Moreover, these four local fig cultivars yielded bigger fruits than new and underutilized fig cultivars in California, which weighed less than 40 g on average [34]. The water content was the highest in Comunione (≈87%) and significantly lower in Verde di Natale and Processotto Nero, with ≈82 and ≈84%, respectively (Table 3). The early-ripening cultivar, Processotto Nero, had the highest amount of TSS (16.2 °Brix), followed by Natalese Nera, whereas Comunione and Verde di Natale had around 10 °Brix. The pH values were in the range of 4–5, similar to values reported in Italy and other countries [32,37–39]. The titratable acidity (TA) showed significant differences among the four cultivars; in particular, the TA was very low for Verde di Natale (1.00 g/L) and the highest value was measured for Natalese Nera, with 2.81 g/L. It has been recently reported that drying time can be reduced from 40 h to 27 h by cutting fig samples into quarters [40]. Thus, the thin fig disks require a reduced time for drying, with consequent positive effects on fig quality. Fig cut into quarters presented significantly higher total phenolic content and total antioxidant activity with respect to the whole figs [40]. Moreover, artificial drying, using cabinet dryers, similar to our device, increased the total phenolic content and total antioxidant activity of figs after the drying process with respect to the traditional sun-drying procedure [40].

Table 3. Chemical traits of the four fig cultivars.

Parameter	Processotto Nero	Comunione	Natalese Nera	Verde Di Natale
Edible part (%)	94 a	95 a	94 a	91 b
Water (%)	82.34 b	86.75 a	84.34 ab	83.87 b
TSS (°Brix)	16.2 a	10.6 c	14.2 b	10.4 c
pH	4.76 a	4.35 b	4.41 b	4.83 a
TA (titratable acidity as g/L malic acid)	1.81 c	2.28 b	2.81 a	1.00 d

Within each row, means with different letters are significantly different according to the Tukey's test, at $p < 0.05$.

3.2. Sensory Panel Evaluation

Direct sun drying is a process based on the exposure of fruits under the sun; in particular, the fruits can be dried directly on the tree, or are harvested fresh or semi-dried and placed on trays, left to dry under ambient conditions or in tunnels [41]. However, this type of drying requires clean days and high air temperature, conditions that are not possible for late-ripening cultivars in Puglia region or in other countries at that time of the year. Moreover, although solar drying is a sustainable process, it has a low efficiency and fruits are exposed to air for a longer duration, with possible negative consequences on fruit quality (insects, dust, pests, etc.) [8]. The dryers could be powered by photovoltaic panels, making the whole process more energy sustainable, a very important aspect in these times in every country.

The data obtained from all 15 sensory descriptors, based on a 1–10 grading scale, are provided in Table 4 for both groups.

Table 4. Attributes of the descriptive sensory evaluation by Groups 1 and 2 for each of the four fig cultivars.

	Processotto Nero		**Comunione**		**Natalese Nera**		**Verde Di Natale**	
Group	1	2	1	2	1	2	1	2
Appearance								
Palatability	5.70 a	6.64 a	3.70 b	6.36 a	5.30 ab	7.45 a	5.40 ab	6.27 a
Brightness	4.65 a	5.91 a	3.80 a	5.73 a	3.75 a	5.45 a	4.75 a	5.27 a
Intensity	5.70 a	7.36 a	4.10 a	6.27 a	5.65 a	8.36 a	5.30 a	6.00 a
Flavor								
Palatability	4.30 a	5.73 a	3.85 a	5.00 a	4.65 a	4.27 a	4.45 a	4.45 a
Persistence	3.50 a	4.73 a	3.40 a	4.64 a	2.55 a	3.45 a	3.70 a	4.00 a
Intensity	4.15 a	4.55 a	4.15 a	5.27 a	3.20 a	3.27 a	4.25 a	3.91 a
Taste								
Intensity	5.75 a	6.73 a	5.25 a	5.82 a	4.60 a	6.00 a	5.20 a	6.82 a
Persistence	5.75 a	6.73 a	5.25 a	7.44 a	5.55 a	5.73 a	5.45 a	5.91 a
Crispness	6.10 ab	6.91 a	6.30 ab	5.91 a	6.65 a	7.45 a	4.65 b	6.50 a
Juiciness	4.00 a	4.64 a	2.65 a	3.64 a	2.45 a	2.91 a	3.45 a	4.73 a
Sapidity	4.40 a	5.73 a	3.85 a	4.91 a	4.50 a	5.18 a	4.35 a	5.36 a
Hardness	5.30 a	6.27 a	5.15 a	5.27 a	5.85 a	5.73 a	4.50 a	5.00 a
Adhesiveness	5.75 a	5.82 a	6.05 a	4.64 a	6.80 a	3.55 a	5.75 a	6.20 a
Palatability	4.70 ab	7.18 a	3.75 b	6.60 a	5.00 ab	5.82 a	5.65 a	6.36 a
Overall Acceptability	*5.63 a*	*7.27 a*	*4.58 a*	*5.73 a*	*5.10 a*	*6.00 a*	*6.11 a*	*6.00 a*

Within each row, means with different letters are significantly different according to the Tukey test, at $p \leq 0.05$, for each group and for each cultivar.

Appearance is the first sensory characteristic that influences fruit acceptance by consumers, since it is the first sensory characteristic that consumers perceive in food and definitely drives the choice [39]. The four cultivars were found to be statistically different for visual assessment by Group 1, though with a lower degree of liking than Group 2. The ratings of visual palatability, an overall impression attribute for appearance, were identified, with the highest ratings of 5.70 for Processotto Nero, and of 7.45 for Natalese Nera, by Groups 1 and 2, respectively (Table 4). During postharvest storage, the dried fruits of white cultivars commonly receive SO_2 application to inhibit enzymatic and non-enzymatic browning, whereas dark cultivars do not receive SO_2 application because the dark skin conceals any darkening [42]. Color maintenance is an important commercial factor and can significantly affect the acceptance of the product by consumers; thus, dark-skinned cultivars could be advantageous.

Significant higher values for Processotto Nero might be explained by a more homogeneous texture assessment (60% vs. 40% presence of defects) compared to the other cultivars; for this parameter, Verde di Natale ranked second. It should be pointed out that intensity and brightness attributes had no influence on the appearance, and no significant differences were reported by either Group 1 or Group 2 (Table 4).

With regards to flavor, together with appearance, a very important sensory quality of a food [43], no differences were detected for the four cultivars by either Group 1 or Group 2 (Table 4). Verde di Natale and Processotto Nero were the most appreciated dried fig disks for both groups of panelists for their flavors.

The four fig cultivars showed a general acceptance according to the hedonic ratings for appearance and flavor, as also recently reported for the evaluation of pecan cultivars [44], although the resulting differences among the cultivars were significant for this latter species.

When considering the taste, the most palatable cultivar was considered to be Verde di Natale by Group 1, which was significantly different with respect to the other cultivars (Table 4). Natalese Nera was also considered by Group 1 to be significantly different with respect to the others when considering the crispness (Table 4). No significant differences among the cultivars were noticed by Group 2 with regard to the taste (Table 4).

In the overall acceptability score, Verde di Natale and Processotto Nero were the most liked by Group 1 and Group 2, respectively. The two types of panelists appreciated different cultivars: white skin for young people and dark skin for mature and experienced ones.

In this study, the overall acceptability of the cultivars from the panelists of Group 2 ranged between 5.73 and 7.27, with all of the ratings above the middle point of the scale and indicating a common acceptance of the four cultivars. Instead, the panelists of Group 1 presented generally less appreciation (between 4.58 and 6.11). Regardless of the panelists group, the minimum score was noticed for Comunione. In general, the dried fig disks of the cultivars tasted by Group 2 presented higher scores than the ones tasted by Group 1.

The flavor descriptors for evaluation of the cultivars (Figure 3) showed the highest appreciation for the disks of Processotto Nero, with some differences between the two groups of panelists. Group 1 perceived more black red fruit, grassy, rancid, and other flavors, whereas Group 2 perceived more floral, cooked, and also black red fruit flavors (Figure 4).

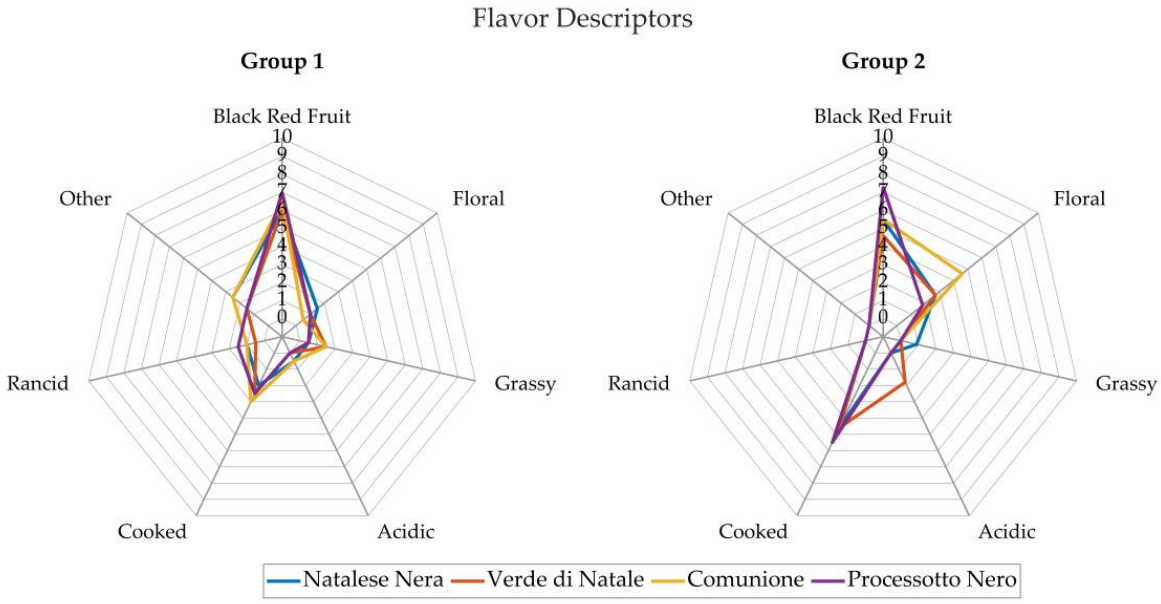

Figure 3. Flavor evaluation of the four cultivars.

The taste evaluation showed differences between the cultivars and between the two groups of panelists (Figure 4). Processotto Nero and Verde di Natale are still the two most appreciated cultivars, and the panelists of Group 2 preferred more black red fruit, cooked, and sweet flavors, whereas panelists of Group 1 appreciated both the black red fruit and sweet flavors, and, to a lesser extent, the bitter and cooked tastes (Figure 5). Consumer hedonic ratings are associated with perceived sensory attributes and their intensity levels, determining the degree of pleasure experienced during consumption and the association with flavors and tastes most liked [45].

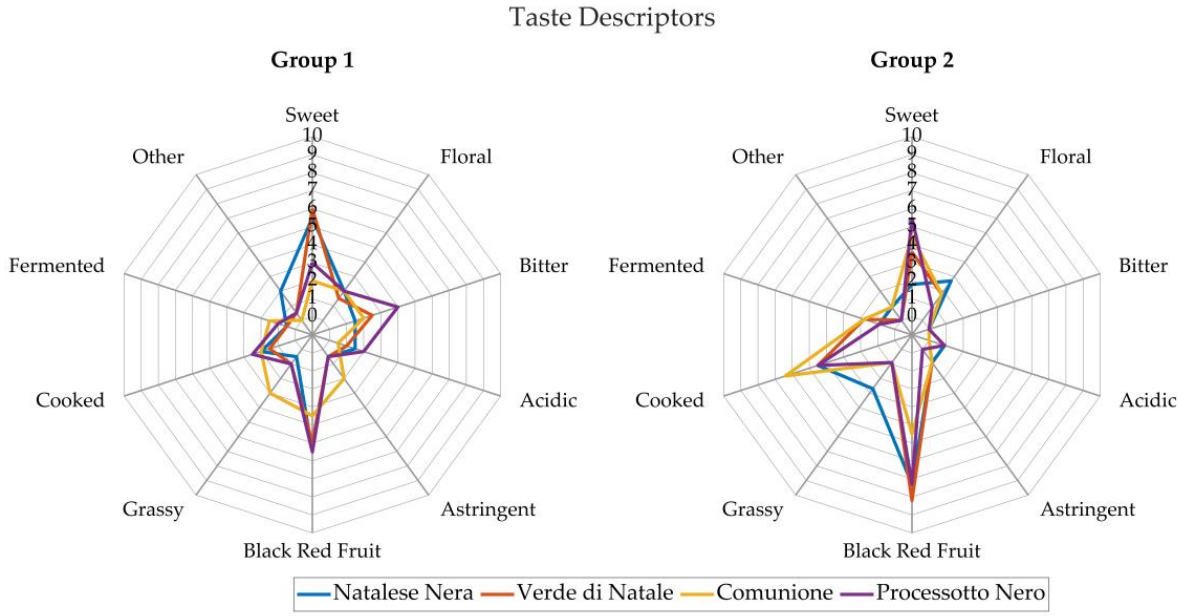

Figure 4. Taste evaluation of the four cultivars.

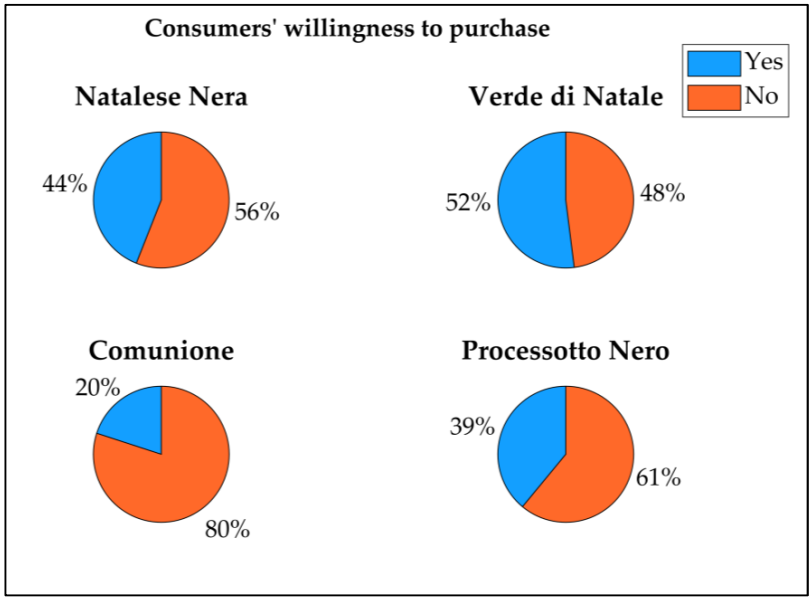

Figure 5. The willingness to purchase the fig disks.

The sensory values found after the processing phase highlighted some differences between the two groups of panelists. In particular, the values described by Group 1 are closer to average values, whereas Group 2 reported more extreme sensory scores. In the overall final score of the processed dried fig disks, the preferred disks were not the same between the two groups, since group 1 appreciated Verde di Natale and Group 2 preferred Processotto Nero; it seemed to be a difference between young consumers and adult ones, so the products could be targeted to different consumers, even in two different periods of the season.

One of the main goals of sensory research is to identify the key points of overall consumer acceptance [46]. The overall acceptance for the dried fig disks resulted in a mix of several attributes and their interaction; often, consumers do not pay equal attention to all sensory attributes [43]. In this study, the drivers of overall acceptance of these processed fig products were the black red fruit flavor, appearance, and sweetness. This study also suggested the importance of flavor, in particular of black red fruits, to the liking of the

consumers, maybe associated with healthy compounds which are more identified in black red fruits. Trying to determine the single effect of each attribute on consumer acceptance is not easy, since many attributes jointly contribute to the overall liking and interactions that exist between the various attributes [47]. In a recent study in Tunisia, figs dried under plastic tunnels were more appreciated than figs dried in the open air, indicating that drying techniques can affect the satisfaction and the acceptance of the consumers [30]. Moreover, this could be considered a positive aspect, since late-ripening cultivars must be artificially dried, due to the climatic conditions at that time of the season.

The intention to buy this new processed fig product was evident for Verde di Natale, whereas the cultivar Comunione was not so appreciated (Figure 5). We also have to take into account that the main fig cultivar for producing dried figs in Italy is still the Dottato, cultivated in Calabria, Campania, and Puglia Region (and in other fig countries of the world under the name Kadota), with green skin and very sweet pulp, but ripening at the end of August; this is the standard cultivar used as a reference by Italian consumers for the taste of dried fig [48]. However, dried fig disks can be considered a new product to be presented with different characteristics for various consumers, i.e., young and adult people.

This research indicated that there are further possibilities for the cultivation of fig, in particular local and underutilized cultivars. From the figs, through the drying process, a new product can be obtained that can present this old fruit in a modern way. Cultivars with dark skin and late ripening, not or only partially used for fresh consumption, could be used for processing. More cultivars could be evaluated for either drying (whole fruit, slices, or quarters) or obtaining innovative products for different consumers (ice cream, jam, etc.). The rich germplasm of the fig can be a source not only for sustainable horticultural production, but also for the food sector.

4. Conclusions

The processing of fresh fig fruits into dried fig disks can be a possible alternative for the consumption of figs. Data from pomological and chemical traits, together with the sensory panel data, were useful to evaluate this new product obtained from dried figs of local underutilized cultivars of Puglia Region. Figs have been sun-dried as whole fruits since centuries, but the possibility of presenting dried figs in a new manner could offer many advantages. The most important aspects of these fig disks include the following: disks can be obtained from underutilized local cultivars, and targeted for the different consumers; the thin disks could attract young consumers, due to their black red fruit flavor suggesting healthy properties; late-ripening and dark-colored skin cultivars could be used for processing, extending the product from the end of summer until December, with varying tastes and flavors; these disks could promote a higher consumption of figs, often forgotten amongst the fruits, favoring the cultivation of old and valuable cultivars.

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