horticulturae

Article

The Artichoke "Bianco di Pertosa": The Enhancement of Crop Residues through Environmentally Friendly Uses

Enrica De Falco [1], Antonello Senatore [2], Graziana Roscigno [3] and Maria Pergola [1,*]

[1] Degree Course of Agriculture, Dipartimento di Farmacia, Università degli Studi di Salerno, Via Giovanni Paolo II, 132, 84084 Fisciano, Italy
[2] S.I. Impresa (Azienda Speciale C.C.I.A.A. Napoli), 80133 Napoli, Italy
[3] Association "I Colori del Mediterraneo—Tingere con le Piante", 84050 Magliano Vetere, Italy
* Correspondence: mpergola@unisa.it; Tel.: +39-320-7875-447

Abstract: The cultivation of the artichoke (*Cynara scolymus* L.) is widespread all over the world, but the largest area of cultivation is in the Mediterranean basin. It is a plant of Mediterranean origin with countless uses, whose cultivation should be preserved as agrobiodiversity, on which food safety and environmental sustainability depend. Moreover, there is the need to increase the sustainability of food systems also by recovering food loss across the supply chain and identifying ways to best utilise discharged food biomass. Effective waste management is critical to increase the environmental performance of the food system to reduce emissions, energy consumption, and waste disposal. The aims of the research were the quantification of the cultivation and processing residues of the artichoke "Bianco di Pertosa" (Salerno, Southern Italy), a plant resource that has become a driving force for the territory and their recovery, and the evaluation of the possible use in different sectors for the development of highly eco-compatible alternative products and processes. To this end, different types of determinations were carried out on heads and senescent leaves: physical measurements (diameter, height, gross and net weight of the heads, number of leaves per stem, and biomass); chemical determinations (nutritional value, humidity, ashes, proteins, crude fibres, crude fats, fatty acids, total carbohydrates, sugars, metals, and calories); and determination of the dyeing power. Results showed that the incidence of residues on the total fresh biomass was very high with values between 58.5% and 69%, confirming the high availability of biomass deriving from artichoke processing residues that can be used in various ways. In particular, the quantity of leaves was equal to 2.8 tons ha^{-1} in dry weight, while the residues of primary and secondary heads amounted to 1.4 tons ha^{-1} in dry weight. The determination of the nutritional label has highlighted a high presence of minerals, in particular, calcium, potassium, and iron; a low Na/K ratio; a high fibre content; and a favourable composition in unsaturated fatty acids. Good results were also obtained in the dyeing determination, thus making crop residues of artichoke a sought-after material for dyeing fabrics and more. These results are important to enhance territories and their resources through the development of eco-compatible processes based on the principles of a circular economy, with a low impact on the environment and safeguarding biodiversity.

Keywords: circular economy; *Cynara scolymus* L.; residues; sustainability; nutritional value; natural dye

check for updates

Citation: De Falco, E.; Senatore, A.; Roscigno, G.; Pergola, M. The Artichoke "Bianco di Pertosa": The Enhancement of Crop Residues through Environmentally Friendly Uses. *Horticulturae* **2022**, *8*, 900. https://doi.org/10.3390/horticulturae8100900

Academic Editor: Costas Stathopoulos

Received: 14 September 2022
Accepted: 27 September 2022
Published: 30 September 2022

1. Introduction

The artichoke (*Cynara scolymus* L.) is a perennial plant of Mediterranean origin [1–3], confirmed by the current vulgar name in the various languages: "*artichaut*" in French; "artichoke" in English; "*articiocco*" in some dialects of northern Italy derive from the neo-Latin "*articactus*", while from the Arabic "*harsciof*" derive the Italian "*carciofo*" and the Spanish "*alchachofa*". In some countries of the eastern Mediterranean basin, the words "*kinara*" or "*angynara*" have been preserved from the ancient Greek [4].

In the world, the cultivated area of the artichoke is about equal to 116 thousand hectares (ha), with a production of about 1.52 million tons, of which 0.61 are produced in Europe [5]. Italy is the largest artichoke producing country in the word, with a cultivated area of just over 38,000 ha and a total production of flower heads equal approximately to 367,000 tons [5], where the greatest expansion of this crop is in Apulia, Sicily, Sardinia, Campania, Lazio, and Tuscany [6].

The cultivation of the artichoke has spread especially in southern Italy as an annual crop, where the transplanting in summer made it possible to anticipate harvests in the autumn period, in order to extend the offer of the fresh product on the market [7]. The edible part is the immature inflorescence (capitula or heads) represented by the fleshy base of the flower heads (receptacle or "bottom") and by the more tender internal bracts that surround it before flowering.

The artichoke plays an important role in the Mediterranean diet and in the food pyramid that well represents the Italian style. It provides a low calorie intake and is rich in minerals (potassium, calcium, phosphorus, and iron). Studies over the last few decades have highlighted the presence of numerous bioactive compounds that carry out important protective actions for health, as has been thoroughly analysed in the review of De Falco et al. [8]. The interest in functional foods was further accentuated with the spread of the pandemic due to COVID-19, and the consequence of the search for "really healthy foods" by consumers who have the Mediterranean diet as a reference increased the consumption of artichoke [9,10]. Moreover, the artichoke is also an important medicinal plant due to the presence of orthodiphenolic compounds, chlorogenic acid, and cynarin, known since ancient times for their therapeutic action on liver diseases [11]. A first analysis of the polyphenol content in the flower heads of different artichoke biotypes of the Campania region, including the Bianco of Pertosa artichoke, was carried out by Fratianni et al. [12] who verified the effective presence of these metabolites in the flower heads, with differences related to the specific genotype.

Italy, where domestication occurred, has the greatest biodiversity of artichoke germplasm [4]. The preservation of biodiversity, defined in 1992 by the United Nations Conference on Environment and Development (UNCED), is the basis of sustainable development in the next years until 2050, together with the development of production models based on the circular economy (CE) [13]. These indications are the basis of the rediscovery of the role of the agriculture that led to its multifunctional activity defined by the Organisation for Economic Co-operation and Development in 2000 [14], capable of providing products and services of various kinds in addition to food (alimentary safety, territorial equilibrium, conservation of the landscape and environment, alimentary supplying guaranty). So, agriculture becomes a resource for the territory and contributes greatly to the sustainability of local settlements and to the connection with other productive and service sectors (agri-tourism, nature and landscape management, social farming) [15]. Moreover, from a CE perspective, the recovery of cultivation waste and processing residues plays a very important role, identifying processes with a low environmental impact to develop sustainable cycles where the waste of one process becomes a resource for another. Indeed, a main CE objective is the maximisation of the value of the resources in use to reduce emissions, energy consumption, and waste disposal [16,17].

Generally, the artichoke is characterised by a very low harvest index [18]; therefore, the cultivation determines abundant residues constituted mainly by the leaves at the end of the harvest and by the bracts deriving from the various preparations for food use [1,19–21]. These waste materials represent about 80–85% of the total plant biomass [22] and are, on the one hand, an environmental problem [1], but on the other hand, a biomass rich in minerals and secondary metabolites [23,24] that can be used to obtain products with high added value [25]. Remarkable is the use of artichoke leaves and residues from the industrial processing of flower heads in the livestock sector as a fresh product or to prepare artichoke flours or silage [26].

In recent years, some works have reported the results relating to the recovery of secondary metabolites for supplements in the human diet from artichoke residues [1,27–29]. As for the studies conducted on local varieties, Coinu et al. [30] analysed the polyphenol content in the leaves with external bracts of the Violetto di Toscana artichoke, with the aim to establish a correlation between polyphenol subclasses and the antioxidant activity. The study conducted by Pagano et al. [22] to evaluate artichoke by-products in the residues of Bianco of Pertosa and IGP of Paestum reported a remarkable overall phenolic content and an amount of inulin with higher levels in bracts (3.8–8.2 g per 100 g dry matter).

On the other hand, for what we know, the components of the residues of artichoke that contribute to defining the nutritional value of a food and its caloric energy have not been identified. In addition, currently, there are other sectors in which residues can be recovered, such as that of natural dyes [31]. Nowadays, the rediscovery of natural colours in various sectors, including textiles, is mainly linked to the need to obtain safer products with a lower environmental impact, easily integrated into a circular economy model [32]. The results of the research conducted by Grifoni et al. [33] highlighted the opportunity of eco-friendly dyeing procedures based on the use of natural colours on hemp fabric providing it with UV protective properties to have "useful for health" products, as it was already established to produce food additives and nutraceuticals.

The present work intends to re-elaborate data collected in previous research conducted on the colouring power of the artichoke Bianco of Pertosa [34] in the perspective of a circular economy and sustainability of production processes. So, the aims of this work were the quantification of the cultivation and processing residues of the artichoke Bianco of Pertosa and the evaluation of their possible use in different sectors for the development of highly eco-compatible alternative products and processes (Figure 1), which is also useful to the development of the territories, according to the latest EU programming directives.

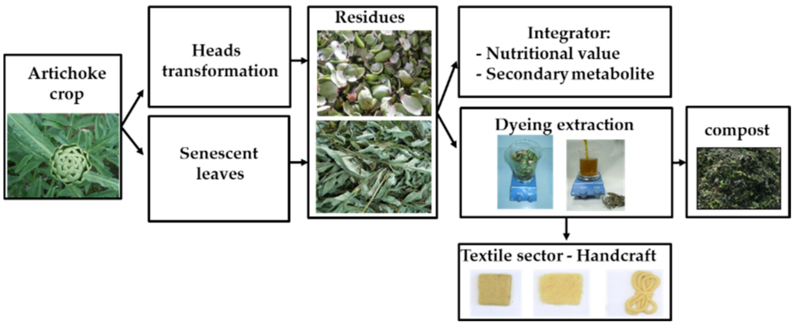

Figure 1. Flowchart of the recovery of artichoke cultivation and processing residues Bianco of Pertosa.

2. Materials and Methods

2.1. Agronomic Measurements

The measurements to quantify the processing residues were carried out during the period of processing of the immature heads (end of April—beginning of May), corresponding to commercial ripeness, on the main heads ("mammarelle") and secondary heads, according to the ordinary procedures followed for the preparation of the transformed product to be preserved in olive oil. The measurements were carried out at the laboratory of the "Consorzio Carciofo bianco" (in Pertosa, SA) at the commercial maturity on the main heads and secondary heads. For both types, diameter, height, gross weight, and net weight (flower heads without processing residues) were measured with 20 repetitions for each parameter. The bracts discarded during the process of manufacturing the artichoke heads in oil were representative samples of the residues. The weight and number of bracts removed for each flower head were determined. The water content of the bracts was determined by drying in an oven at 50 °C for 48 h, with three repetitions.

The flower heads used for the surveys were provided from two farms falling within the Bianco artichoke area, located respectively in the territory of Caggiano (SA, 378 m a.s.l.)

and Pertosa (SA, 232 m a.s.l.). The cultivation residues represented by the leaves during the senescence phenological stage were collected in the field (last ten days of June) in the same farms. Thus, in each field, the number of leaves per stem and the biomass were detected on 20 plants. The water content was determined by drying the leaves at 50 °C for 48 h, with three repetitions.

The artichokes were grown on clayey-sandy soils (ISSS Classification), with pH of 7, low electrical conductivity, high cation exchange capacity, with a medium amount of nitrogen and phosphorus and high in potassium. The average annual rainfall is about 800 mm; the minimum winter temperature often drops below 0 °C, even if slightly; the average annual temperature is 15 °C. These climatic characteristics do not hinder the success of the cultivation as the artichoke Bianco of Pertosa is a biotype that begins to produce in late spring. In addition, the root system acts as an accumulation of reserve substances, capable of supporting vegetative reactivation after summer quiescence. In fact, the plant has a large root system which may reach up to 5 m [35]. Moreover, autumn and winter rainfall, coinciding with the crop cycle, is usually sufficient to guarantee a good production result without irrigation. The combination of these factors allows for the obtaining of good yields in biomass in conditions of low energy input and this is particularly suitable for a better adaptation to the climatic changes in progress.

The artichoke cultivations where the measurements were made were carried out according to the ordinary cultivation technique for the variety [36].

2.2. Reagent and Chemicals

As in De Falco et al. [37], all chemicals were analytical grade and supplied by Merck KGaA (Darmstadt, Germany). Ultrapure water was obtained from a Milli-Q®water purification system (Millipore, Bedford, MA, USA).

2.3. Determination of Nutritional Label

The analyses for the determination of the nutritional values of the processing residues (bracts collected at the Laboratory of the "Consorzio of Carciofo bianco" from the preparation of artichokes for conservation in olive oil) and crop residues (senescent leaves) were carried out at the public Chemical Laboratory of the Chambers of Commerce of Naples (ACCREDIA 394, UNI CEI EN ISO/IEC 17025).

All analyses were carried out following the official AOAC procedures [38] on samples previously dried at 50 °C for 48 h and homogenised by Grindomix (GM200).

For each analysis, the principle of repeatability was applied according to which the difference between the results of two determinations carried out simultaneously or quickly one after the other, on the same sample, in the same laboratory, by the same operator, must not exceed 0.05 per 100 g of sample, in accordance with the internal documents of the laboratory regarding quality assurance. Each determination was performed on 3 samples.

The moisture content was determined by weight loss of 1 g of plant sample at 105 °C in an ISCO oven until a constant weight was reached [38].

The ash content (the content in mineral salts) was determined by incinerating 10 g of plant sample in a muffle at 550 °C for 4 h [38].

The crude protein content was calculated as 6.25xnitrogen content. The latter was estimated by the Kjeldahl method [39] (Digester K-438, Distiller B-324, BUCHI Italia s.r.l Cornaredo, Italy).

The raw fibre content (lignin and cellulose) was determined from the dried residue remaining after digestion of 5 g of plant sample with 0.125 N H_2SO_4 and 0.125 N NaOH solutions, until boiling, for 30 and 60 min, respectively. The Weende method [38] was applied using the Velp Scientifica™ FIWE3 Model Raw Fiber Extractor (Thermo Fisher Scientific Inc., Stockholm, Sweden), according to the manufacturer's instructions.

Total amount of carbohydrates was calculated as a difference of 100 in water, ashes, proteins, and fats, as: 100—(% water)—(% ash)—(% protein)—(% fat).

Determination of sugars (glucose and fructose) was undertaken by the colorimetric-enzymatic method using the automated multi-parametric Analyser Y15 SinaTech together with the relative analysis kits (BioSystems, S.A., Barcelona, Spain), according to the manufacturer's instructions.

The determination of the total lipids was conducted by extracting 10 g of plant samples with hexane through the Soxhlet extraction device (VWR International PBI s.r.l., Milan, Italy) [38].

Energy value, per 100 g of product, was calculated as: kcal = (% protein $\times$ 4) + (% fat $\times$ 9) + [(% carbohydrates $-$ % fibre) $\times$ 4] + (% fibre $\times$ 2); kj = 17 $\times$ (g protein + g carbohydrate) + 37 $\times$ (g lipid) + 8 $\times$ (g fibre) [40].

2.4. Determination of Minerals

As in De Falco et al. [37], ash samples were digested in a 1% nitric acid (HNO_3) solution using a microwave digestion unit, model MARS 6™ (CEM SRL, Cologno al Serio, Italy). The content of minerals was determined by inductively coupled plasma mass spectrometry (ICP-MS) with quadrupole detector, model Bruker 820-MS (Bruker Daltonics, Macerata, Italy).

2.5. Determination of Fatty Acids

Fatty acids were determined using gas chromatography with flame ionisation detection (GC-FID), starting from total lipids [37]. The trans-esterification procedure was applied with potassium hydroxide in methanol ($KOHCH_3OH$) 2N (11.2 g in 100 mL), by shaking in a vortex for 5 min and left to stand for another 5 min. The upper phase containing the fatty acid methyl esters (FAME) was recovered [41,42].

2.6. Dyeing Process

The dyeing power of the processing and cultivation residues of the artichoke have been tested following the protocols developed in the context of the group of research for the definition of eco-compatible procedures with low environmental impact [31,43].

The dyeing power of the artichoke residues was tested with the commercial 100% wool yarn Merino Baby (Nm 1/3000), used as a reference sample for the fine-tuning of all processes. In addition, the wool yarn, carded wool, and felt from the recovery of wool from Italian native breeds were tested.

All yarns and fabrics were mordanted with a water solution of metal salts: 40% of potassium alum and 10% of cream of potassium hydrogen tartrate at the constant temperature of 70 °C before being dyed. The proportions were doubled for the mordanting of carded wool and felt.

The extraction of the pigments was carried out starting from the dried bracts and leaves. The drying was carried out in an oven at 50 °C for 48 h. Both materials were not ground but only cut. Dried material was used because it guarantees an efficient system of conservation of the raw material.

Regarding the extraction process, the following protocols were adopted:

- Dried bracts with a ratio between the material to be dyed and the plant material used for the preparation of the colour bath of 1:1, temperature of 70 °C for 1 h;
- Dried leaves using the ratio of 1:1, temperature of 70 °C for 1 h (Extraction Process 1);
- Dried leaves using the ratio of 1:1, temperature of 70 °C for 30 min, and temperature of 60 °C for the next 90 min (Extraction Process 2).

The colour baths were analysed using a Thermo Scientific Multiskan Spectrum dual beam spectrophotometer with version 2.2 software. The reading of the extracts was performed in 1.5 mL semi-micro PMMA UV cuvettes in the range of wavelengths 250–700 nm.

The dyeing was carried out using the colour baths prepared according to the methods described above, respecting the aforementioned ratios between plant material and fibres to be dyed; 100% white Merino wool yarn was used as the reference standard.

The dyeing process was carried out by maintaining the colour bath with the material to be dyed immersed for 1 h at 70 °C. These conditions preserve the quality of pigments as assessed in previous research [31].

All the dyed samples were exposed to a white lamp Philips TLD 18 watt/96 and were classified according to the Munsell Colour System, which is based on three colour dimensions: a hue that indicates the contribution of the main shades (red, yellow, green, blue, and purple); value (a measure of darkness or lightness of a colour on a scale of 0–10); and chroma, which is the degree saturation of a colour [44].

Since the dyeing results obtained on the sample yarns (100% Merino Wool Baby Nm 1/3000) regarding chroma and value were better with the extracts of the leaves adopting Extraction Process 2 with respect to Process 1, the tests on the other materials (wool from Italian native breeds) were carried out with Extract 2.

All the tested samples underwent colour fastness light tests and the standard scale of blue dyeing [45] was adopted (1 = poor; 8 = excellent).

2.7. Statistical Analysis

The significant differences ($p < 0.05$) between parameters under study were evaluated by means of one-way analysis of variance (ANOVA). Pearson's correlation analysis (among parameters of a greenhouse trial) was performed at ** $p = 0.01$. The statistical analysis was performed with the MSTAT-C software package (Michigan State University, MI, USA).

3. Results and Discussion

3.1. Study Area and Product Description

In the Campania region, the cultivation of artichokes has ancient origins dating back to Roman times. The importance of this vegetable grew thanks to the great consideration it acquired at the Neapolitan court, so much so that the definition of the artichoke as "king of the garden" goes back to Charles of Bourbon, King of Naples from 1734 to 1739 [46].

In this region, there is a high biodiversity represented by numerous valuable biotypes and this has been ascribed also to traditional methods of propagation, based on on-farm vegetative reproduction, resulting in multi-clonal populations [47], whose name generally recalls the areas of origin: Capuanella, Violetto di Castellamare, artichoke of Montoro, artichoke of Pietrelcina, artichoke of Procida, Pignatella (Sarnese-Nocerino countryside), Paestum artichoke IGP (Protected Geographical Indication). All these belong to the so-called group of Romaneschi, characterised by pigmentation of the bracts, and Bianco di Pertosa, which is characterised by the lack of purple pigmentation (Figure 2), and all with an absence of spines.

Figure 2. The artichoke Bianco of Pertosa.

The Bianco of Pertosa artichoke has been included among the "Traditional varieties" of the Campania Region since 2000 and became a Slow Food Presidium in 2003; moreover, the uniqueness of the variety has been ascertained on a morphological and genetic basis [36]. The cultivation area is included in the municipalities of Auletta, Pertosa, Caggiano, and

Salvitelle, falling in the lower area of the Tanagro river within the Cilento and Vallo of Diano National Park (Salerno). Currently, it has become a driving force for the development of the territory.

The cultivation of traditional varieties has the advantage of having plants better adapted to ongoing climate changes, but also to be able to procure reproduction material on site, eliminating the costs of logistics for transporting the seedlings. Indeed, as Martin-Gorriz et al. [48] pointed out, in artichoke production a remarkable contribution to air acidification potential derives from the plantlet production (11%), due to long-distance transport (for sulphur oxide emissions from fossil fuel combustion).

3.2. The Agronomic Measurements

Both primary and secondary heads used for the measurements were harvested in the last ten days of April at Pertosa (Field 1) and in the second decade of May at Caggiano (Field 2). The different harvest dates depended on the altitude of the two locations under consideration, respecting the typical trends reported for this traditional variety.

Average data of height, diameter, and weight of heads are reported in Table 1. The analysis carried out highlights that significant differences in the parameters detected were recorded between the diameter of primary and secondary heads and not between the experimental fields. At the same time, the comparison between data relating to primary and secondary heads showed significant differences in the total fresh weight.

Table 1. Results of the surveys carried out on heads at harvest and on processing residues.

Head	Field 1 (Pertosa)		Field 2 (Caggiano)	
	Primary	Secondary	Primary	Secondary
Parameters [1]				
Height (cm)	7.9 ±0.5 ab	7.2 ± 0.4 b	8.2 ± 0.8 a	7.7 ± 0.6 ab
Diameter (cm)	7.8 ± 1.3 a	5.8 ± 0.6 b	7.2 ± 0.6 a	6.0 ± 0.7 b
Fresh total weight (g)	142.8 ± 44.2 a	80.3 ± 12.3 c	119.4 ± 7.3 ab	94.4 ± 13.5 bc
Fresh clean head weight (g)	59.2 ± 20.4 a	32.6 ± 4.5 b	41.8 ± 7.4 b	28.7 ± 1.9 b
Fresh discarded bracts (g)	83.6 ± 26.0 a	47.6 ± 8.2 b	81.8 ± 14.5 a	65.3 ± 12.4 ab
Discarded bracts/total weight (%)	58.5 ± 4.0 b	59.3 ± 2.3 b	68.5 ± 5.1 a	69.2 ± 3.7 a
Bracts discarded (n.)	31.8 ± 8.5 a	19.9 ± 2.8 b	29.0 ± 3.9 a	25.3 ± 3.3 ab
Bracts water content (%)	86.4 ± 0.4 a	86.0 ± 0.7 a	84.4 ± 0.6 ab	82.8 ± 0.9 b
Residual dry weight (g)	11.4 ± 3.5 a	6.7 ± 2.1 b	12.7 ± 2.3 a	11.2 ± 2.1 a

[1] Data are reported as mean values for head ± SD (n = 3 for bracts' water content percentage, n = 20 for other parameters). Means followed by different letters in the same row are significantly different (p = 0.05, Tukey test).

Referring to vegetable residues, Table 1 shows their high value, which was always greater than the weight of the "clean head ready" for transformation and conservation. Furthermore, in both experimental fields, the fresh biomass of the waste deriving from the primary heads was higher than that of the secondary heads, in relation to the greater weight of the flower heads. The incidence of residues on the total fresh biomass was always very high, without differences between primary and secondary heads. The values were between 58.5% and 69%, with the highest values corresponding to Field 2 where lower water contents were also recorded. These data confirm the high availability of biomass deriving from artichoke processing residues that can be used in various ways.

The correlations among the parameters measured on heads at harvest and on processing residues (Table 2) highlighted significant positive relationships and confirmed the above; in particular, for the relation between weight of the heads and discarded bracts (0.92).

Table 3 shows data relating to crop residues represented by the senescent leaves. Values of fresh and dry biomass per stem were equal to 207.1 and 93.5 g in the surveys carried out in the Field 1, and to 150.6 and 56.3 g in Field 2, respectively. The higher biomass recorded in Field 1 was determined essentially by the higher number of leaves per stem rather than by the unit weight of the leaves, which resulted in slightly different values in the two sampling sites. The water content was higher in the samples taken at Field 2 due to a less advanced drying phase.

Table 2. Pearson's correlation between the parameters measured on heads at harvest and on processing residues [1].

	Diameter of Head (cm)	Bracts Discarded (n.)	Fresh Total Weight of Head (g)	Fresh Clean Head (g)	Discarded Bracts (g)
Height of head (cm)	0.63	0.54	0.66	0.44	0.74
Diameter of head (cm)	-	0.82	0.90	0.83	0.83
Bracts discarded (n.)	-	-	0.86	0.67	0.88
Fresh total weight of head (g)	-	-	-	0.89	0.92
Fresh clean head (g)	-	-	-	-	0.69

[1] The correlations were all significant for $p = 0.01$ (n = 20).

Table 3. Measurements of artichoke senescent leaves [1].

	Field 1 (Pertosa)	Field 2 (Caggiano)
Leaves per stem (n.)	16.7 ± 4.0	13.1 ± 2.4
Fresh total weight (g)	207.1 ± 59.7	150.6 ± 63.7
Unitary fresh weight (g)	12.4 ± 2.1	11.5 ± 2.1
Water content (%)	53.8 ± 1.2	65.7 ± 0.8
Total dry weight (g)	93.5 ± 27.6	56.3 ± 21.8
Unitary dry weight (g)	5.6 ± 1.0	4.3 ± 0.7

[1] Data are reported as mean values ± SD (n = 3 for water content %, n = 20 for other parameters). For all parameters means are not significantly different ($p = 0.05$).

Data were further processed to estimate the potential amount of residues per hectare deriving from the heads and leaves in a traditional crop of the artichoke Bianco of Pertosa. The results reported in Table 4 show that the quantity of leaves was equal to 7.1 tons per hectare, corresponding about to 3 tons ha^{-1} in dry weight, while the residues of primary and secondary heads amounted to 9.7 tons ha^{-1}, corresponding to 1.4 tons ha^{-1} in dry weight.

Table 4. Estimation of the residues from the cultivation of the artichoke Bianco of Pertosa.

Technical Data [1]	Quantity
Planting density (plants ha^{-1})	10,000
Stems per plant (n)	4
Primary heads per plant (n)	5
Secondary heads per plant (n)	10
Leaves per stem (n) [2]	14.9
Residues [2]	
Fresh biomass	
Bracts from primary heads (tons ha^{-1})	4.1
Bracts from secondary heads (tons ha^{-1})	5.6
Leaves in natural drying phase (tons ha^{-1})	7.1
Dried biomass	
Bracts from primary heads (tons ha^{-1})	0.6
Bracts from secondary heads (tons ha^{-1})	0.8
Leaves in natural drying phase (tons ha^{-1})	2.8

[1] The technical data are recovered on the traditional cultivation of the artichoke Bianco of Pertosa. [2] Data derived from the effected measurements.

3.3. The Nutritional Label

The nutritional composition of the discarded bracts and senescent leaves are reported in Table 5. The bracts showed a high content of proteins (16.6%) and fibre (17.5%) and was low in fats (1.6%). The examination of the data relating to the composition of the leaves, on the other hand, highlighted a lower content regarding proteins (7.6%) but was higher in fats (5.3%) and above all in ashes (18.9% compared to 9.8% of the bracts). The fibre content was high in both cases (15.8% and 17.5%, respectively, for leaves and bracts) and this is of great interest as it was reported earlier in the introduction.

Table 5. Nutritional label and energy value for the discarded bracts and senescent leaves of the artichoke Bianco of Pertosa.

Composition [1]	Bracts	Leaves
Protein (g/100 g)	16.6 ± 0.2 a	7.6 ± 0.1 b
Fat (g/100 g)	1.6 ± 0.1 b	5.3 ± 0.1 a
Carbohydrates (g/100 g)	44.9 ± 0.1 a	42.7 ± 0.1 a
of which sugars (g/100 g)	3.3 ± 0.1 a	3.5 ± 0.1 a
Fibre (g/100 g)	17.5 ± 0.1 a	15.8 ± 0.1 a
Ashes (g/100 g)	9.8 ± 0.1 b	18.9 ± 0.1 a
Water content (%)	9.7 ± 0.3 a	9.8 ± 0.1 a
Energy (Kcal/100 g)	356.8 ± 0.1 a	330.6 ± 0.1 a
(Kj/100 g)	1493.7 ± 0.1 a	1383.8 ± 0.1 a

[1] Values are given for 100 g of dried product. Data are reported as mean values ± SD (n = 3). Means followed by different letters in the same row are significantly different (p = 0.05, Student t-Test).

Table 6 reports data relating to the composition of main fatty acids: both in the bracts and in the leaves the content of those unsaturated was higher, with greater values in the leaves. Among them, the most represented were linoleic (ω-6) and linolenic (ω-3) fatty acids. The oleic acid (ω-9) content of the leaves was also high (20%). These results are of great interest considering the importance of consuming food rich in omega-3 and omega-6 fatty acids for the prevention of some diseases [49,50].

Table 6. Composition in fatty acids for the discarded bracts and senescent leaves of the artichoke Bianco of Pertosa.

Unsaturated fatty acids (%) [1]		Bracts	Leaves
Palmitoleic	C16:1	0.3 ± 0.001	0.3 ± 0.005
Margaroleic	C17:1	tr	0.2 ± 0.001
Oleic	C18:1	5.2 ± 0.005	20.0 ± 0.005
Linoleic	C18:2	18.8 ± 0.010	15.4 ± 0.015
A-Linolenic/β-Linolenic	C18:3	10.5 ± 0.010	11.9 ± 0.025
Eicosenoic	C20:1	1.3 ± 0.010	1.4 ± 0.005
Total [2]		36.1 ± 0.030 b	49.2 ± 0.010 a
Saturated fatty acids (%) [1]		**Bracts**	**Leaves**
Myristic	C14:1	0.4 ± 0.005	0.3 ± 0.005
Palmitic	C 16:1	11.6 ± 0.001	17.7 ± 0.005
Margaric	C17:1	0.2 ± 0.005	0.2 ± 0.005
Stearic	C 18:1	1.9 ± 0.005	4.2 ± 0.010
Arachidic	C 20:1	5.7 ± 0.010	3.4 ± 0.010
Behenic	C 22:1	1.1 ± 0.010	1.5 ± 0.005
Lignoceric	C 24:1	1.1 ± 0.001	3.5 ± 0.001
Total [2]		22.0 ± 0.020 d	30.6 ± 0.040 c

[1] Data of unsaturated and saturated fatty acids for bracts and leaves (values for 100 g of dried product) are reported as mean values ± SD (n = 3); tr = trace. [2] The totals of unsaturated and saturated fatty acids means are reported for the bracts and leaves; means followed by different letters on the row are significantly different (p = 0.05, Tukey test).

Among the saturated fatty acids, a high content was found for the palmitic acid (11.6% and 17.7% in the bracts and in the leaves, respectively).

The mineral content of the residuals, reported in Table 7, showed that the highest values were found regarding potassium and calcium in the leaves; however, potassium was also high in the bracts, along with iron content.

Table 7. Mineral content in the residues of bracts and leaves and daily reference intake [40].

Composition [1]	Bracts	Leaves	DRI (mg/d)
Sodium (mg 100 g^{-1})	101.6 ± 0.1 fgh	309.3 ± 0.1 d	2000
Potassium (mg 100 g^{-1})	452.6 ± 0.2 c	4029.3 ± 50.9 a	2000
Magnesium (mg 100 g^{-1})	56.1 ± 0.1 fgh	27.5 ± 1.4 h	375
Calcium (mg 100 g^{-1})	154.2 ± 0.1 efg	1309.8 ± 55.5 b	800
Iron (µg 100 g^{-1})	268.2 ± 0.2 de	44.6 ± 0.4 gh	14
Manganese (µg kg^{-1})	64.9 ± 0.1 fgh	14.7 ± 0.4 h	2
Copper (µg 100 g^{-1})	161.2 ± 0.1 efg	5.6 ± 0.4 i	1
Zinc (µg kg^{-1})	173.5 ± 0.1 ef	20.7 ± 0.9 h	10

[1] Data of mineral content for bracts and leaves (values for 100 g of dried product) are reported as mean values ± SD (n = 3). Means followed by different letters are significantly different (p = 0.05, Tukey test).

Referring to sodium content, values were equal to 101.6 mg 100 g^{-1} for bracts and 309.3 mg 100 g^{-1} for leaves, lower than those reported in the literature [51]. In both cases, a good Na/K ratio (little sodium and a lot of potassium) resulted, with particularly low values in the leaves (0.22 and 0.08 for the bracts and for the leaves, respectively).

The comparison with the data reported by the European Union [40] for daily reference intake (DRI) in adults for some macro-mineral (potassium, calcium, and magnesium) and micro- and trace-elements (copper, iron, manganese, zinc) confirmed that both artichoke residues may be considered a good source of mineral elements.

From the examination of the results relating to the characterisation of the nutritional label of the residues of bracts and leaves of the artichoke "Bianco di Pertosa", a very favourable composition emerged, due to, in particular, the high content of fibres and minerals and the low caloric intake for both types of waste. Furthermore, for bracts, the advantageous content of lipids with a high presence of unsaturated fatty acids should also be emphasised. This composition is of great interest as these components have a significant nutritional value as they become part of important physiological functions. Indeed, this biomass rich in minerals and secondary metabolites, as also confirmed by Chihoub et al. [23] and Claus et al. [24], can be used to obtain products with high added value and plays an important role in the management of the artichoke [25]. Recent studies have highlighted the presence of bioactive compounds, mainly (poly)phenols [52], "non-nutrient" components that carry out important protective actions for health [25,53]. The richness in soluble and insoluble fibre (especially cellulose as well as hemicellulose and lignin), makes the artichoke useful for maintaining intestinal function and controlling blood levels of glucose and cholesterol, as well as contributing to the achievement of a sense of satiety. Moreover, as stated by [25], the flower head is rich in inulin (water-soluble polysaccharide, fructose polymer belonging to the FOS family with reserve functions in the plant), and is not digested by intestinal juices but metabolised by microorganisms such as bifidobacteria and therefore has prebiotic properties. The inulin content in the flower head is between 1% and 6% of the fresh weight and varies according to the genotype, the phenological stage, and the time of harvest [25]. Some components of the artichoke showed a significant hypoglycaemic activity in vitro. Chlorogenic acid has in fact been identified as a potent and specific inhibitor of glusio-6-phosphate translocase. It would also be able to reduce the absorption of the favoured carrier intestinal glucose [51]. So, artichoke is a recommended food for diabetics, and the good fibre content in the edible bracts is useful for promoting intestinal peristalsis [51,54]. A further beneficial action is due to the polyphenolic components with the contribution to the prevention of atherosclerosis with associated reduction of the risk of cardiovascular diseases, mainly connected to the antioxidant and hypocholesterolemic properties.

So, the results obtained, integrated with those reported by Fratianni et al. [12], that confirmed the presence of polyphenols in flower heads, and Pagano et al. [22], related to the by-product composition (remarkable overall phenolic content: 0.5–1.7 g per 100 g dry matter; higher levels of inulin in bracts: 3.8–8.2 g per 100 g dry matter; cellular antioxidant activities of bract and leaf extracts—half maximal effective concentration (EC50) = 26.6 – 124.1 mg L^{-1}—better than or similar to that of a commercial leaf extract, and related to the dicaffeoylquinic acid levels, particularly to 1,5-dicaffeoylquinic acid), offer excellent development prospects for the preparation of food supplements.

3.4. The Dyeing Characterisation

Results of the spectrophotometric analysis of the extracts prepared with the dried bracts and leaves according to the two extraction processes (1 and 2) are shown in Table 8 and highlight differences in the materials and extraction methods.

Table 8. Visible UV spectrophotometric analysis.

	Main Wavelengths of the Visible UV Spectrum (nm)																												
Bracts		255	260	265	280	285	290	305	310	315			330	335	340	345	350	355		370								680	695
Leaves (1)	235	255									320	325	330			345	350												
Leaves (2)								305	310	315	320	325	330	335	340	345	350	355	360	370	375	380	385	390	395	400	405		

Observation of the spectrum relating to bracts highlights a high number of peaks with wavelengths from 255 to 695 nm. Lutein, identified by the wavelength of 350 nm, was found to be present in all spectra according to Angelini et al. [51], who reported that luteolin was the main pigment identified in the artichoke head and leaves. Peaks at 680 and 695 nm, corresponding to the chlorophylls, were present only in bracts and not in leaves, with both extraction processes. The colour of the head of artichoke is conditioned by the more or less abundant presence of chlorophyll in the organs exposed to light and by the anthocyanin pigments placed in the outermost areas of the epidermis of the bracts, which give a purplish colour to the flower head, and which varies according to the variety and are missing in the artichoke Bianco of Pertosa [55].

Referring to the spectra of the extracts of the leaves, Figure 1 shows a much greater number of peaks and a much wider range in the extraction Process 2 than that identified with Process 1.

The results of the classification according to the Munsell Colour System are reported in Table 9 and confirm the observations made on the spectra. All the processes allowed us to obtain a yellow colour on the standard Merino wool. However, the colour obtained with the extract from the leaves with Process 2 resulted in a more intense and brighter yellow falling fully into the table of yellows (10Y) with a higher shade value (9). Instead, the colour obtained from the bracts, where chlorophyll was registered, showed a green component falling into the 7.5 Y table with value equal to 7.

In any case, solidity recorded satisfactory values equal to 4, as the minimum acceptable limit for application in a textile dyeing procedure is 3 [56].

Analogously, the results obtained with the yarns and carded wool recovered from sheep of Italian indigenous breeds (Table 9) have been very positive and suggest the concrete possibility of developing a supply chain to create a link between raw material, dye, and territory.

Table 9. Classification of dyed material according to the Munsell system.

	Munsell System			
	Shades	Value	Chroma	Solidity
Merino Wool Baby (Standard)				
Bract extraction	7.5Y	7	4	4
Leaves (1)	7.5Y	8.5	8	4
Leaves (2)	10Y	9	8	4
Wool from native Italian sheep breeds				
Wool yarn (2) (Alto Tammaro, BN)	5Y	8.5	8	4
Carded wool (2) (Alto Tammaro, BN)	5Y	8.5	8	4
Felt (2) (Biella)	7.5Y	8.5	8	4

(1) Colour bath obtained from the artichoke leaves with Extraction Process 1. (2) Colour bath obtained from the leaves with Extraction Process 2.

The versatility of the starting plant material, the colour baths obtained, and the appreciable results achieved, lay the foundations for a possible use of the artichoke Bianco of Pertosa in numerous fields, besides the textile one [57]. At the same time, the use of residues in the textile supply chain, thanks to the eco-compatibility of the process adopted, does not affect their subsequent recovery in the composting process to increase soil fertility on farms.

4. Final Considerations

The results showed a significant quantity of residues of the artichoke Bianco of Pertosa, and the determination of the nutritional label offers excellent development prospects for the development of a possible use for the preparation of supplements. Good results were also obtained in the dyeing sector, thus making crop residues a sought-after material for dyeing fabrics and more.

The outcomes of this work are important for enhancing the resources of a territory by strengthening the link with the agricultural sector and its multifunctionality through the development of eco-compatible processes, with a low impact on the environment, in which biodiversity and the principles of a circular economy are safeguarded.

Author Contributions: Conceptualisation, E.D.F. and G.R.; Methodology, E.D.F. and G.R.; Software, G.R.; Validation, G.R. and E.D.F.; Formal Analysis, G.R.; Investigation, A.S.; Resources, E.D.F.; Data Curation, A.S.; Writing—Original Draft Preparation, M.P.; Writing—Review and Editing, E.D.F. and M.P.; Visualisation, E.D.F. and M.P.; Supervision, E.D.F.; Project Administration, E.D.F.; Funding Acquisition, E.D.F. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Acknowledgments: We thank the farms Pucciarelli, Cafaro, and the Consortium artichoke Bianco of Pertosa for allowing the surveys to be carried out and Bianca Landi for her contribution in conducting the surveys and analyses.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Zayed, A.; Farag, M.A. Valorization, extraction optimization and technology advancements of artichoke biowastes: Food and non-food applications. *LWT—Food Sci. Technol.* **2020**, *132*, 109883. [CrossRef]
2. Acquadro, A.; Barchi, L.; Portis, E.; Mangino, G.; Valentino, D.; Mauromicale, G.; Lanteri, S. Genome reconstruction in Cynara cardunculus taxa gains access to chromosome-scale DNA variation. *Sci. Rep.* **2017**, *7*, 5617. [CrossRef] [PubMed]
3. Curci, P.L.; De Paola, D.; Danzi, D.; Vendramin, G.G.; Sonnante, G. Complete chloroplast genome of the multifunctional crop globe artichoke and comparison with other Asteraceae. *PLoS ONE* **2015**, *10*, e0120589. [CrossRef] [PubMed]
4. Pignone, D.; Sonnante, G. Wild artichokes of South Italy: Did the story begin here? *Genet. Resour. Crop Evol.* **2004**, *51*, 577–580. [CrossRef]
5. FAOSTAT. 2020. Available online: https://www.fao.org/faostat/en/#data/QCL (accessed on 16 August 2022).

6. ISTAT. Aggiornamento del 6° Censimento dell'agricoltura. 2022. Available online: http://dati.istat.it/ (accessed on 5 September 2022).
7. Grabowska, A.; Caruso, G.; Mehrafarin, A.; Kalisz, A.; Gruszecki, R.; Kunicki, E.; Sękara, A. Application of modern agronomic and biotechnological strategies to valorise worldwide globe artichoke (*Cynara cardunculus* L.) potential—An analytical overview. *Ital. J. Agron* **2018**, *13*, 1252. [CrossRef]
8. De Falco, B.; Incerti, G.; Amato, M.; Lanzotti, V. Artichoke: Botanical, agronomical, phytochemical, and pharmacological overview. *Phytochem. Rev.* **2015**, *14*, 993–1018. [CrossRef]
9. De Faria Coelho-Ravagnani, C.; Corgosinho, F.C.; Sanches, F.L.F.Z.; Prado, C.M.M.; Laviano, A.; Mota, J.F. Dietary recommendations during the COVID-19 pandemic. *Nutrients* **2021**, *13*, 1752.
10. Rodriguez-Leyva, D.; Pierce, G.N. The Impact of Nutrition on the COVID-19 Pandemic and the Impact of the COVID-19 Pandemic on Nutrition. *Nutrients* **2021**, *13*, 1752. [CrossRef]
11. Council of Europe. *European Pharmacopoeia*, 10th ed.; Council of Europe: Beograd, Serbia, 2021.
12. Fratianni, F.; Tucci, M.; De Palma, M.; Pepe, R.; Nazzaro, F. Polyphenolic composition in different parts of some cultivars of globe artichoke (Cynara cardunculus L. var. scolymus (L.) Fiori). *Food Chem.* **2007**, *104*, 1282–1286. [CrossRef]
13. European Commission. UE Circular Economy Action Plan. Available online: https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en (accessed on 3 September 2022).
14. Yu, M.; Yang, Y.; Chen, F.; Zhu, F.; Qu, J.; Zhang, S. Response of agricultural multifunctionality to farmland loss under rapidly urbanizing processes in Yangtze River Delta, China. *Sci. Total Environ.* **2019**, *666*, 1–11. [CrossRef]
15. Todorova, S.; Ikova, J. Multifunctional Agriculture: Social and Ecological impacts on the organic farms in Bulgaria. *Procedia Econ.* **2014**, *9*, 310–320. [CrossRef]
16. Castro, C.G.; Trevisan, A.H.; Pigosso, D.C.A.; Mascarenhas, J. The rebound effect of circular economy: Definitions, mechanisms, and a research agenda. *J. Clean. Prod.* **2022**, *345*, 131–136. [CrossRef]
17. Kalmykova, Y.; Sadagopan, M.; Rosado, L. Circular economy—From review of theories and practices to development of implementation tools. *Resour. Conserv. Recycl.* **2018**, *135*, 190–201. [CrossRef]
18. Lattanzio, V.; Lafiandra, D.; Morone-Fortunato, I. Composizione chimica e valore nutritivo del carciofo (*Cynara scolymus* L.). In *Studi sul Carciofo, a Cura di V. Marzi e V. Lattanzio, Atti III Congresso Internazionale sul Carciofo, Cynar e CNR Editori*; Industria Grafica Laterza: Bari, Italy, 1981.
19. Barracosa, P.; Barracosa, M.; Pires, E. Cardoon as a sustainable crop for biomass and bioactive compounds production. *Chem. Biodivers.* **2019**, *16*, e1900498. [CrossRef]
20. Ben Salem, M.; Affes, H.; Ksouda, K.; Dhouibi, R.; Sahnoun, Z.; Hammami, S.; Zeghal, K.M. Pharmacological studies of artichoke leaf extract and their health benefits. *Plant Foods for Human Nutrition* **2015**, *70*, 441–453. [CrossRef]
21. Jiménez-Moreno, N.; Esparza, I.; Bimbela, F.; Gandía, L.M.; Ancín-Azpilicueta, C. Valorization of selected fruit and vegetable wastes as bioactive compounds: Opportunities and challenges. *Crit. Rev. Environ. Sci. Technol.* **2019**, *50*, 2061–2108. [CrossRef]
22. Pagano, I.; Piccinelli, A.L.; Celano, R.; Campone, L.; Gazzerro, P.; De Falco, E.; Rastrelli, L. Chemical profile and cellular antioxidant activity of artichoke by-products. *Food Funct.* **2016**, *7*, 4841. [CrossRef]
23. Chihoub, W.; Dias, M.I.; Barros, L.; Calhelha, R.C.; Alves, M.J.; Harzallah-Skhiri, F.; Ferreira, I.C.F.R. Valorisation of the green waste parts from turnip, radish, and wild cardoon: Nutritional value, phenolic profile and bioactivity evaluation. *Food Res. Int.* **2019**, *126*, 108651. [CrossRef]
24. Claus, T.; Maruyama, S.A.; Palombini, S.V.; Montanher, P.F.; Bonafé, E.G.; de Oliveira Santos Junior, O.; Matsushita, M.; Visentainer, J.V. Chemical characterization and use of artichoke parts for protection from oxidative stress in canola oil. *LWT—Food Sci. Technol.* **2015**, *61*, 346–351. [CrossRef]
25. Lattanzio, V.; Kroon, P.A.; Linsalata, V.; Cardinali, A. Globe artichoke: A functional food and source of nutraceutical ingredients. *J. Funct. Foods* **2009**, *1*, 131. [CrossRef]
26. Meneses, M.; Megìas, M.D.; Madrid, M.J.; Martìnez-Teruel, A.; Hernàndez, F. Ensiling capacity, chemical composition and multiresidue evaluation of fresh artichoke (Cynara scolymus, L.) by-product to be used in ruminant feeding. *Options Méditerr.* **2005**, *67*, 351–354.
27. Farag, M.A.; Elsebai, M.F.; Khattab, A.R. Metabolome based classification of artichoke leaf: A prospect for phyto-equivalency of its different leaf origins and commercial preparations. *J. Pharm. Biomed. Anal.* **2018**, *158*, 151–159. [CrossRef] [PubMed]
28. Ruiz-Aceituno, L.; García-Sarrió, M.J.; Alonso-Rodriguez, B.; Ramos, L.; Sanz, M.L. Extraction of bioactive carbohydrates from artichoke (Cynara scolymus L.) external bracts using microwave assisted extraction and pressurized liquid extraction. *Food Chem.* **2016**, *196*, 1156. [CrossRef] [PubMed]
29. Pizzichini, M.; Romani Pizzichini, A.; Pizzichini, D.; Russo, C.; Pinelli, P. *Process for Producing Refined Nutraceutic Extracts from Artichoke Waste and from other Plants of the Cynara Genus*; Isr Ecoindustria s.r.l.: Latina, Italy, 2008.
30. Coinu, R.; Carta, S.; Urgeghe, P.; Mulinacci, N.; Pinelli, P.; Franconi, F.; Romani, A. Dose-effect study on the antioxidant properties of leaves and outer bracts of extracts obtained from Violetto di Toscana artichoke. *Food Chem.* **2007**, *101*, 524–531. [CrossRef]
31. De Falco, E.; Caroccia, R.; Russo, L.; Lombardi, G.; Roscigno, G.; Gaeta, A. *Proceedings VIII Convegno Biodiversità*; Arti Grafiche Favia—Modugno (BA): Lecce, Italy, 2010; pp. 167–169.
32. Bechtold, T.; Mussak, R.; Mahmud-Ali, A.; Ganglberger, E.; Geisseler, S. Extraction of natural dyes for textile dyeing from coloured plant wastes released from the food and beverage industry. *J. Sci. Food Agric.* **2006**, *86*, 233. [CrossRef]

33. Grifoni, D.; Roscigno, G.; De Falco, E.; Vece, A.; Camilli, F.; Sabatini, F.; Fibbi, L.; Zipoli, G. Evaluation of Dyeing and UV Protective Properties on Hemp Fabric of Aqueous Extracts from Vegetal Matrices of Different Origin. *Fibers Polym.* **2020**, *21*, 1750–1759. [CrossRef]
34. De Falco, E. *Tingere con il Carciofo Bianco di Pertosa*; Collana MIdA Agricoltura; Editore MIDA—Musei Integrati dell'ambiente: Pertosa, Italy, 2012.
35. Archontoulis, S.V.; Struik, P.C.; Vos, J.; Danalatos, N. Phenological growth stages of Cynara cardunculus: Codification and description according to the BBCH scale. *Ann. Appl. Biol.* **2010**, *156*, 253–270. [CrossRef]
36. Magnifico, V.; Pepe, R.; Rosti, A.; Palumbo, A.D.; Santonicola, L.; Donato, R. Il Carciofo Bianco di Pertosa. *Inf. Agrar.* **2005**, *7*, 61–64.
37. De Falco, E.; Zanti, R.; Senatore, A.; Vitti, A. Opportunities of spontaneous edible plants collected in southern Italy (Campania Region) as functional food. *Ital. J. Agron.* **2019**, *14*, 1540. [CrossRef]
38. AOAC. *Official Methods of Analysis*, 16th ed.; Association of Official Analytical Chemists: Arlington, VA, USA, 1995.
39. Jiang, B.; Tsao, R.; Li, Y.; Miao, M. Food Safety: Food Analysis Technologies/Techniques. In *Encyclopedia of Agriculture and Food Systems*; Academic Press: Cambridge, MA, USA, 2014; pp. 273–288.
40. Regulation EU. No 1169/2011 of the European parliament and of the Council of 25 October 2011 on the provision of food information to consumers. *Off. J. Eur. Union.* **2011**, *L304*, 18–63.
41. European Union. Regulation (EEC) 2568/91 of 11 July 1991 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis. *Off. J. Eur. Union.* **1991**, *L248*, 36–47.
42. European Union. Regulation (EU) 2015/1833 of 12 October 2015. *Off. J. Eur. Union.* **2015**, *L266*, 35–44.
43. De Falco, E.; Di Novella, N. *Le Piante Tintorie del Cilento e Vallo di Diano*; Fondazione MiDA: Pertosa, Italy, 2011.
44. Color, M.; Munsell, A.H. *Munsell Book of Color*; Glossy Edition; NoseLab Equipment s.r.l.: Nova Milanese, Italy, 1976.
45. UNI EN ISO 105-B02:2014—Textiles. Tests for Colour Fastness Colour Fastness to Artificial Light: Xenon Arc Fading Lamp Test. Available online: https://www.en-standard.eu/bs-en-iso-105-b02-2014-textiles-tests-for-colour-fastness-colour-fastness-to-artificial-light-xenon-arc-fading-lamp-test/ (accessed on 15 May 2022).
46. Bianco, V.V.; Calabrese, N.; Zalum Cardon, M. *Letteratura, Pittura, Cultura In "Il Carciofo e il Cardo"*; Art Servizi Editoriali: Bologna, Italy, 2009; pp. 32–43.
47. Portis, E.; Mauromicale, G.; Barchi, L.; Mauro, R.; Lanteri, S. Population structure and genetic variation in autochthonous globe artichoke germplasm from Sicily Island. *Plant Sci.* **2005**, *168*, 1591–1598. [CrossRef]
48. Martin-Gorriz, B.; Gallego-Elvira, B.; Martínez-Alvarez, V.; Maestre-Valero, J.F. Life cycle assessment of fruit and vegetable production in the Region of Murcia (south-east Spain) and evaluation of impact mitigation. *J. Clean. Prod.* **2020**, *265*, 121656. [CrossRef]
49. Simopoulos, A.P. Omega-3 fatty acids and antioxidants in edible wild plants. *Biol. Res.* **2004**, *37*, 263–277. [CrossRef]
50. Harris, W.S.; Mozaffarian, D.; Rimm, E.; Kris-Etherton, P.; Rudel, L.L.; Appel, L.J.; Engler, M.M.; Engler, M.B.; Sacks, F. Omega-6 Fatty Acids and Risk for Cardiovascular Disease. *Circulation* **2009**, *119*, 902–907. [CrossRef]
51. Angelini, R.; Calabrese, N.; Ponti, I. *Il Carciofo e il Cardo*; Bayer CropScience srl: Milano, Italy, 2009.
52. Domínguez-Fernández, M.; Irigoyen, Á.; de los Angeles Vargas-Alvarez, M.; Ludwig, I.A.; De Peña, M.P.; Cid, C. Influence of culinary process on free and bound (poly)phenolic compounds and antioxidant capacity of artichokes. *Int. J. Gastron.* **2021**, *25*, 100389. [CrossRef]
53. Di Venere, D.; Pieralice, M.; Linsalata, V.; Gatto, M.A.; Sergio, L.; Calabrese, N. Biochemical evaluation of artichoke cultivars propagated by seed. *Acta Hortic.* **2016**, *1147*, 89–94. [CrossRef]
54. Pandino, G.; Lombardo, S.; Mauromicale, G. Globe artichoke leaves and floral stems as a source of bioactive compounds. *Ind. Crops Prod.* **2013**, *44*, 44–49. [CrossRef]
55. Marzi, V.; Lattanzio, V. Studi sul carciofo. In Proceedings of the 3° Congresso Internazionale sul Carciofo, Bari, Italy, 27–30 November 1979.
56. Bechtold, T.; Mahmud-Ali, A.; Mussak, R. *Handbook of Waste Management and Co-Product Recovery in Food Processing*; Waldron, K.W., Ed.; Woodhead Publishing: Sawston, UK, 2007; pp. 502–533.
57. De Falco, E.; Roscigno, G. Valorizzazione delle risorse territoriali attraverso il recupero di residui agricoli e piante spontanee come coloranti naturali per la bioedilizia. In Proceedings of the XII Convegno Nazionale Biodiversità 2018, Teramo, Italy, 13–15 June 2018.