

## Physical-chemical properties of Corema album (white crowberry or camarinha)

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### Abstract

This study evaluated the biometric characteristics (diameter, mass), the chemical properties (moisture content, fiber, total and reducing sugars, total soluble solids, total acidity), and some physical properties (color, texture). The results obtained showed that the Corema album berries had an average diameter of  $8.63 \pm 0.84$  mm, and a mass of  $0.66 \pm 0.11$  g. Regarding the chemical analysis, the results obtained show an average moisture content of  $87.89 \pm 4.01$  % (fresh weight) and a fiber content of  $36.52 \pm 1.96$  % (dry matter). The percentage of total and reducing sugars was  $62.80 \pm 0.77$  % and  $41.24 \pm 1.74$  % (dry matter), respectively. The result also showed Brix<sup>o</sup> of  $6.20 \pm 0.03$  and a total acidity of  $10.7 \pm 0.1$  % (Citric Acid). This study allowed concluding that the berries Corema album at study showed parameters of diameter and mass higher than those reported in the bibliography. It was also possible to conclude through the chemical analyzes performed that these berries are a very rich source of water, fibers and total sugars. Finally, these results confirm that Corema album berries have multiple physical-chemical properties that may be of high interest to the market of commercial berries.

### Keywords

Corema album, Physical characteristics, Chemical properties, Color, Texture.

# Physical-chemical properties of *Corema album* (white crowsberry or camarinha)

## Conference Topic - TS1 - Food Engineering and Properties

### 1. Introduction

*Corema album* (L.) D. Don ('white crowsberry' or Camarinha) is a fruit that has been consumed by people in Iberian Peninsula from the Islamic period (500 PE). The local population still reaps the fruit of sand dunes [1]. Although the loss of natural ecosystems and socioeconomic changes caused a decrease in consumption, this fruit presents possibilities in the worldwide berry market because of its novelty and fresh acid taste [2].

The genus *Corema* belongs to the family *Ericaceae* and Order *Ericales*. Displays only two species, *Corema conradii*, endemic to North West coast of the United States of America, and *Corema album* (L.) D. Don, endemic to the Atlantic coast of the Iberian Peninsula. The latter presents a subspecies in the Azorean islands, *C. album* subsp. *azoricum* Pinto da Silva, and the mainland subspecies is called *Corema album* ssp *album* [3].

The plants flower from February through April. The fruit ripens June-July in the south and August-September in the north, and they remain on the plants until October through December depending on the geographical location [4].

Fruit berries of the *Corema album* are described as being small with a more or less spherical shape and the color is white or pinkish white when ripe [5]. The ripe fruit is usually completely white with a strong skin. However, there is segregation between genotypes for fruits that remain pearly white, and others where the fruit becomes translucent. Translucency is when the seeds (often constituted by at least three) become visible from the outside of the fruit. Fruits of some genotypes with translucent berries develop a reddish tinge surface [4].

The fruit is edible, with an agreeable flavor and very refreshing although the taste is slightly acid. It is rich in sugars and water, and certainly an important food source for coastal animal communities. The *Corema album* fruit quality characteristics include firm skin, acceptable flavour, and sweetness [4].

The fruits have been traditionally consumed in these coastal areas, fresh or made into acid-tasting lemonades, jams and liquors, as appetizer and to treat fevers [2].

Because *Corema album* wild edible berries could be used as a food or food ingredient, the aim of this work was to make the physical and chemical characterization of such fruits

### 2. Experimental Procedure

#### 2.1. Sampling

For this work were evaluated *Corema album* berries, from the North-Centre region of Portugal. The *Corema album* (camarinhas or white crowsberries) used in this study came from the wild, more specifically from the dunes in the region Mira beach, in the district of Coimbra, Portugal. The fruits used in this study were collected in two different degrees of maturation: berries showing totally white and berries pink white or already translucent. These different berries were handled separately.

For the study were collected approximately 250 g of berries, randomly selected from several dune plants from different parts of the same area.

## 2.2. Handling and conservation

After harvesting, the samples were transported to the laboratory in appropriate plastic cuvettes, refrigerated and protected from light.

In the laboratory the sample were separated, cleaned and finally stored until the subsequent analysis. The physical properties were evaluated in the freshly collected samples.

The chemical analyses were performed on the fresh samples as well as on samples that were lyophilized. The lyophilized samples were stored in hermetically closed containers and stored in a dry place away from light.

## 2.3. Biometric characteristics

For the assessment of biometric characteristics, weight and size, 50 berries were randomly selected as representative of each sample. The size of each berry was measured with the aid of an automated caliper rule and the weight was determined through a precision scale.

In view of the values of height and diameter, it was possible to calculate other properties:

$$\text{Average radius (caliber)} = (\text{Height} + \text{Diameter})/2 \quad (1)$$

$$\text{Volume} = \pi \times (4/3) \times (\text{average radius})^3 \quad (2)$$

$$\text{Specific mass (density)} = \text{mass}/\text{volume} \quad (3)$$

## 2.4. Chemical analysis

Moisture content was determined by a Halogen Moisture Analyzer HG53 from mettler Toledo. The operating conditions were as follows: heat source - halogen lamp; drying temperature - 120 °C; speed of drying - 3 (intermediate). The number of repetitions for each sample was three independent measurements.

For the determination of acidity, the sample preparation followed the Portuguese Standard NP-1421, 1985 [6] and the acidity determination was carried out according to the NP-1421, 1977 [7]. For the determination of acidity were performed two independent assays.

The tests for determination of fiber were made following protocols referenced in the Weende method. For the determination of fiber were performed three independent assays in lyophilized samples.

For the determination of total sugars and reducing sugars, the sample preparation followed the Portuguese Standard NP-1420, 1987 [8]. For the determination of sugars were performed two independent assays in fresh samples.

In this work was still it evaluated the soluble solids content by refractometry and the Brix graduation was measured using a refractometer Atago 3T. In all cases three replicates were made.

## 2.5. Color measurement

The color of crowberries (camarinha or *Corema album*) was determined with a colorimeter (Chroma Meter - CR-400, Konica Minolta) in the CIE Lab color space (Figure 1), though the Cartesian coordinates L\*, a\* and b\*. The L\* axis represents lightness and varies from 0 (corresponding to no lightness, i.e., absolute black), to 100 which is maximum lightness (i.e. absolute white). The other axes are represented by a\* and b\* and they are at right angles to each other. The a\* axis varies from green at one extremity (represented by -a) to red at the other (+a), whereas the b\* axis varies from blue at one end (-b), to yellow (+b) at the other. Although in theory there are no extreme values of a\* and b\*, in practice they can be numbered from -128 to +127.

For color evaluation were studied 20 berries.

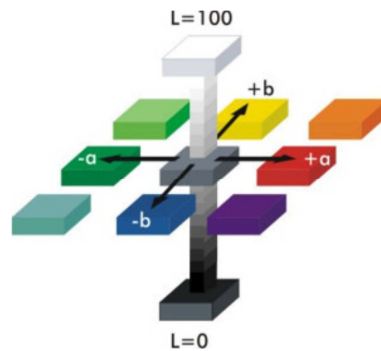


Figure 1 - Hunter Lab Color Space.

The hue variable distinguishes between green, blue, yellow or red. This perception color results from differences of absorption of radiant energy to various wave lengths. Finally the term chroma, also called saturation or purity, indicates as the color differs from gray, i.e. distinguishes between bright and dim colors.

The color is specified in cylindrical coordinates by parameters value, hue angle ( $h^0$ ) and the color saturation or chroma (C), and which can be calculated according to the following equations [9]:

$$Value = \frac{L}{2} \quad (4)$$

$$h^0 = \tan^{-1} \left( \frac{b}{a} \right) \quad (5)$$

$$h^0 = 180 + \tan^{-1} \left( \frac{b}{a} \right) \quad (6)$$

$$C = \sqrt{a^2 + b^2} \quad (7)$$

## 2.6. Texture analysis

To determine the texture attributes (strength and elasticity) were also randomly selected 40 representative berries of each sample. The analyzes were performed with a texturometer TA.XT Plus, from Stable Micro Systems, with the following test conditions: pre-test speed = 1.50 mm/s, test-speed = 1.00 mm/s, post-test speed = 10.00 mm/s, distance = 6 mm, trigger force = 0.05 mm and a load cell of 50 kg. The results were treated with Exponent software TEE (Stable Micro Systems) and from the obtained texture profile (Figure 2) was determined firmness (strength on the highest peak) and elasticity (distance at the highest point).

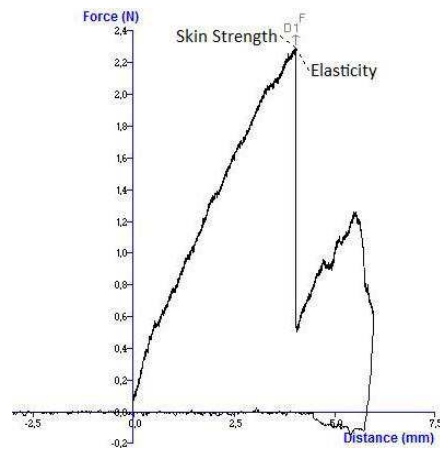


Figure 2 - Texture profile analysis for white crowberry (*Corema album* or Camarinha).

### 3. Results and Discussion

#### 3.1. Biometric characteristics

The Biometric characteristics of *Corema album* (White Crowberry or Camarinha) berries are presented in Table 1. The results obtained for the height measurement showed that the average height was  $8.63 \pm 0.84$  mm.

Table 1 - Biometric characteristics of white crowberry (Camarinha or *Corema album*).

Height (mm)	Diameter (mm)	Average radius /calibre (cm)	Volume (cm <sup>3</sup> )	Mass (g)	Specific mass (g/cm <sup>3</sup> )
$8.63 \pm 0.84$	$9.43 \pm 0.74$	$0.90 \pm 0.06$	$0.39 \pm 0.09$	$0.66 \pm 0.11$	$1.70 \pm 0.18$

In relation to the average value obtained for the diameter, it was found to be  $9.43 \pm 0.74$  mm (Table 1). With regard to diameter, the average value obtained was  $8.63 \pm 0.84$  mm (Table1), which is just slightly higher than those obtained by Oliveira and Dale [4], which stand on the range 5-8 mm. However in the study conducted by Calviño-Cancela [3], it was found that the *Corema album* berries showed a diameter of  $9.0 \pm 0.1$  mm. Hence the value obtained in the present work for diameter does stand in the same range as those reported in literature.

Regarding the average value of the mass (Table 1) it was obtained a mass of  $0.66 \pm 0.11$  g (Table1). In the evaluations made by Oliveira and Dale [4] and by Clavijo et al. [10] it was found that the berries of *Corema album* had a mass  $0.40 \pm 0.06$  g and 0.31-0.42 g respectively. In face of these findings, it is possible to say that the *Corema album* berries evaluated in this study showed a higher mass than usually reported.

In general the *Corema album* (White Crowberry or Camarinha) berries analyzed in this study presented higher mass and caliber than the values obtained by other authors and reported in literature. This difference can to be related with the ripeness of the berries, with the nutritive properties of the dune soil and the edaphoclimatic conditions of the region from where the berries were collected.

### 3.2. Chemical analysis

The results for the chemical analysis made in this study for the samples of *Corema album* (White crowsberry or camarinha), are shown in Table 2.

The mean value obtained for moisture in *Corema album* berries in fresh and after the lyophilization process was  $87.89 \pm 1.04$  % (fw) and  $11.57 \pm 0.02$  % (fw) respectively (Table 2). The works by Clavijo et al. [10] and Santos et al. [11] reported values of moisture also for *Corema album* berries in the fresh state of 75 % and 83.41 %, respectively. Compared to this study it was possible to verify that the berries of *Corema album* under study have higher moisture than documented. This difference may be related to the species or the growing characteristics, namely the soil and climate.

Table 2 - Chemical analyses of white crowsberry (Camarinha or *Corema album*).

Moisture (% fresh weight)		Total fibre (% dry matter)	Sugars (% dry matter)		Soluble solids (°Brix)	Acidity (g/100 g citric acid)
Fresh sample	Lyophilized Sample		Total Sugars	Reducers sugars		
$87.89 \pm 1.04$	$11.57 \pm 0.02$	$36.52 \pm 1.96$	$62.80 \pm 0.77$	$41.24 \pm 1.74$	$6.20 \pm 0.03$	$10.7 \pm 0.1$

The results show that *Corema album* berries are rich in fiber, containing on average  $36.52 \pm 1.96$  % (Table 2). According to Calviño-Cancela [3] it is possible to say that this fruit is very rich in fiber, due to the fact that it exceptionally contains two to four elongated seeds.

The values observed by the determination of total and reducing sugars were  $62.80 \pm 0.77$  and  $41.24 \pm 1.74$  (Table 2), respectively. According to the results reported by Clavijo et al. [10], they obtained 77.1 % of total sugars, also expressed as dry matter, which were relatively higher as compared to those found in this study.

In Table 2 is still possible to find the concentration of soluble solids,  $6.20 \pm 0.03$  °Brix, and acidity,  $10.7 \pm 0.1$  (g citric acid/100 g). In assessing the soluble solids content in *Corema album* berries the researchers Pimpão et al. [1] obtained a value of  $6.8 \pm 0$  Brix°, which is similar to that in the present case.

### 3.3. Color

The values of the color coordinates for the *Corema album* berries are shown in Table 3.

Table 3 - Color parameters of the berries *Corema album*.

Lightness (L)	Redness (a)	Yellowness (b)	Value (V)	Hue (h°)	Chroma (C)
$79.82 \pm 2.82$	$1.27 \pm 2.05$	$5.88 \pm 1.02$	$7.98 \pm 0.28$	$77.29 \pm 13.36$	$6.25 \pm 1.46$

The results obtained showed that the *Corema album* berries have a light color because the value of lightness obtained ( $79.82 \pm 2.82$ ) is closer to the value +100 (white) than to the value 0 (black). With respect to the value of redness ( $1.27 \pm 2.05$ ), it is possible to verify that it is very close to zero, although positive, and hence the sample tends to be just very slightly red and not green (negative value of a). In relation to the parameter b ( $5.88 \pm 2.1$ ), because it is

positive it stands on the yellow, but is low. Thus according to the results one can say that the sample at study presents a light white-yellowish color.

### 3.4. Texture

The values obtained for the textural parameters in the *Corema album* berries are shown in Table 4. The value obtained for hardness was  $1.93 \pm 0.36$  N. The hardness is the maximum force recorded in the first cycle of penetration or compression. In most cases, the hardness is related to the breaking force of the material [9]. In this way it is possible to verify that the surface of the *Corema album* berries have a low resistance to compressive forces thus easily suffering rupture. The value obtained for elasticity was  $2.85 \pm 0.72$  mm. Elasticity is the resilience of the material [9]. In this way it is possible to verify that the berries of *Corema album* do not have a considerable elasticity. Hence, in general the fruits are soft and not elastic.

Table 4 - Hardness and Elasticity of the *Corema album* berries.

Hardness (N)	Elasticity (mm)
$1.93 \pm 0.36$	$2.85 \pm 0.72$

## 4. Conclusions

This study allowed concluding that the *Corema album* berries at study showed parameters of diameter and mass higher than those reported in the bibliography.

It was also possible through the complete chemical analyzes of the *Corema album* berries, to confirm that they are an important source of water, fibers and total sugars.

With regard to the assessment of color it was possible to conclude that the *Corema album* berries have a light color, very approximate to white.

In relation to the texture the results showed that both the hardness and elasticity were low.

Finally, and in view of the results obtained from this study, it is possible to depict an interest in these berries for the market of commercial berries.

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