Physicochemical study of *Rubus fruticosus* of the Mediterranean region of Morocco

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**Abstract:** Blackberry (*Rubus fruticosus*) belongs to the *Rosaceae* family. It is very rich in essential and beneficial elements. In Morocco, despite its nutritional quality, this fruit remains among the forest species that are ignored. The present study has been focused on the physicochemical characterization of this species. The fruits have been harvested from the Mediterranean region of Morocco (Tangier-Tetouan-Al Hoceima). The analysis was made directly after the harvest for the determination of pH value, acidity, Total soluble solid, refraction index, total and reducer sugar levels. Results showed that the fruit is acidic (pH 4.65±0.32), rich in water (70%) and total sugars (27.43±2.67 mg/l). The variation of different physicochemical parameters in all fruit samples collected from different sites may be due to geographical distribution, climatic and edaphic parameters.

**Keywords:** Blackberry; Forest species; Physicochemical analysis; climatic.

1. **Introduction**

Currently, in food, people are looking for plants or their fruits with good nutritional quality and which are beneficial to human health. One of the fruits which we want to enhance in Morocco is the wild bramble (*Rubus fruticosus*) that exists in the Mediterranean forests. Blackberry above all is characterized by the presence of a more or less dense coat of spines on its branches. The spines play two leading roles: the protection and conquest of space. The foot produces shoots. The flowers of the Bramble have five petals, five sepals and many stamens 1.

Fruiting happens in the summer, usually on the twigs of two years. The fruits, fleshy, composed, formed of the agglomeration of small drupes, are edible. *Rubus fruticosus* is located between the 30th and 65th parallels of the northern hemisphere and between the 28th and 40th parallels of the southern hemisphere. Its range extends across Europe, North Africa (Atlas), Southern Africa, South-East Australia, New Zealand, the United States and Chile. This fruit also exists nearer to Ecuador but at higher altitudes (up to more than 2000 m altitude) 1. However, they are mainly widespread in temperate and warm temperate zones 2. Common throughout Europe, it has become naturalized everywhere. It grows mainly in hedges and forests 3.

As for their geographical distribution, fruits of *Rubus* genus are found in fertile areas, both on continents and oceanic islands. The fertilization practices can affect pH, total soluble solids (TSS) and titratable acidity 4,5. The fruit weight, TSS, pH and acidity of wild blackberries in Turkey were between 1.5-2.1 g, 11.3-13.1%, 3.33-3.35 and 0.7-1.0%, respectively 6. The same parameters of blackberry cultivars grown in a different region of Turkey were previously reported between 2.0-6.6 g, 8.98-20.2 %, 3.3-3.6, and 1.0-3.1%, respectively 7,8,9.

Differences gauged between cultivars may be explained by genotype 10,11, growing temperature 12, growing season, maturity at harvest, environmental stress, and other factors 13.

A well-known plant, growing in abundance on wet slopes, along paths, in hedges, bushes, on the edge of forests, in woods where it spreads rapidly. Not to be confused with mulberry, whose fruit is also called blackberry although these fruits are very similar, both in appearance and taste. The data on the
composition of this species in the studies regions, including the information of physicochemical characteristics have not yet been explored.

The knowledge of nutritional quality is started by general physicochemical measures such as measuring pH, dry matter and sugar content. Accordingly, this study aims to characterize this specie by physicochemical parameters and compare between these three regions.

2. Experimental

2.1 Plant material
Wild bramble fruit (Rubus fruticosus) were harvested in Tangier-Tetouan-Al Hoceima area, which covers 17,262 km², located in the extreme north-west of Morocco 14 (Fig. 1). The fruits were harvested at their physiological maturity in the morning and transported in boxes that were well closed and stored at Materials and Resources Valorisation Laboratory, Faculty of Sciences and Technology-Tangier. Our study is focused on three harvests of Rubus fruticosus L. species. The fruits were collected for 4 months (May-June-July and August 2016).

![Figure 1. Geographical location of the harvest region](image)

2.2. Physicochemical analyses
The AOAC international standard methods 16 were used to determine the physicochemical characteristics. Ashes and dry matter (DM) content. The pH measurement was made using a digital pH meter. Titratable acidity (TAc) was measured by the titrimetric method. The refractive index (RI) and the total soluble solid contents (was expressed as %TSS) were determined by a digital refractometer.

2.3. Dosage of total and reducing sugars
Reducing and total sugars obtained after hydrolysis were determined by the Luft-Schoorl method and the number of sugars converted using the Luft-Schoorl chart 17.

2.4. Statistical analyses
Fruit characteristics data were analyzed using analysis of variance (ANOVA).

3. Results and Discussion
Physicochemical parameters of fruits give a general approach to their qualitative character. Table 1 showed the higher value of pH, RI and ash were obtained in the fruits of HG region. Thus, the highest value of total acidity was founded in GH samples followed by HG fruits. The fruits of BM region presented the higher percentage of TSS and ash; on the other hand, this sample presented the lowest value of titratable acidity, RI and ash. Statistically significant differences were recovered between the results of samples from the three regions for all the parameters tested (p<0.05). Results of pH, titratable acidity (TAc) and total soluble solids (TSS) exhibited the average values of 4.65±0.32; 3.25±0.41 and 9.8±0.76% respectively. Our results of TSS and titratable acidity were almost close to the values founded by other results (8.34% and 2.95, respectively) 19.

Whereas, some scientific founded pH values from 3.33 to 4.1 and TSS was 16.2±2.7 19. Moreover, the average pH and titratable acidity values found in the fruits of the three studied populations ranged from 3.06 to 3.11 and 2.99 to 3.28, respectively 20. Values obtained for the three populations studied were higher than those reported by Hirsch et al. (2012) for blackberry (Rubus spp.) cultivars spread in Brazil’s southern region (1.30 to 1.58) 21. The average value of RI and DM results were 1.34±0.005 and 30.29±2.68%, respectively. According to other research, DM levels of R. fruticosus showed a percentage of 36.4% 22. Though the wet mass presented about 70% of the total mass of the fruit, these results were 10% lower than those founded by another research (87.7%) 23.

In general, the water content can be influenced by the age of the plant, the vegetative cycle period and even genetic factors 23-25. This variation can be due also to the different pedoclimatic conditions and geographical distribution 26. The percentage of TSS represents the soluble solid which shows the sugar level in fruits. The balance between TSS and titratable acidity was determined by sugars and organic acids ratio, and this determines the flavor of...
the fruit. This balance obtained was between 1.55±0.38 and 2.3±0.38. The average value of this ratio which was obtained by other publications was 3.06% 18. The mineral matter value obtained was 4.46±2%. However, ash content must have a threshold not to exceed for human and animal consumption. It also varies according to geographic origin 25. Fruit parameters like titratable acidity, pH and TSS contents depend upon the stage of fruits collection and the area climatic and geological condition from where fruits were collected 19.28. Determination of these parameters is of primary interest and first step during the qualitative evaluation of fruits, and it dictates further studies on components which seem more attractive.

Table 1. Physicochemical parameter characteristics of Rubus fruticosus.

| Harvesting site | pH     | Acidity (A) | TSS (%) | TSS/A | RI     | DM %  | Ash % |
|-----------------|--------|-------------|---------|-------|--------|-------|-------|
| BM              | 4.75±0.32 | 4.55±0.66 | 10.5±0.76 | 2.3±0.38 | 1.338±0.005 | 32.24±2.68 | 2.5±2.17 |
| GH              | 4.3±0.32  | 5.8±0.66   | 9±0.76  | 1.55±0.38 | 1.347±0.005 | 27.23±2.68 | 4.1±2.17 |
| HG              | 4.92±0.32 | 4.8±0.66   | 10±0.76 | 2.08±0.38 | 1.349±0.005 | 31.41±2.68 | 6.8±2.17 |
| Mean            | 4.65±0.32 | 5.05±0.66 | 9.8±0.76 | 1.82±0.38 | 1.34±0.005  | 30.29±2.68 | 4.46±2.17 |

BM: Beni messaour/ GH: ghezaoua/ HG: Had Gharbia
RI: Refractive Index / DM: Dry Matter / TSS: total soluble solids/ TAc: titratable acidity

Sugars are the most important constituents of R. fruticosus fruit. They are also responsible of the food sweetness 27. Results showed an average value of 27.43±2.67 mg/l of the total sugars and 22.4±2.6 mg/l of the reducing sugars. The fruits of GH region presented the higher content of reducing and total sugars followed by BM fruits and HG fruits were the last. The variations in sugar content can be attributed to several factors such as the age of the plant, the load of burn, the maturation stage and the physiological state of the fruit during the analysis.

Others factors such as exposure duration to the sun, climate and availability of water can also affect sugar contents 28-33. Therefore, these fruits would constitute a significant source of sugars that provides calories and give fruits their pleasant flavors. Indeed, a high concentration of sugars prevents bacterial proliferation in jams and jellies what contributes to the processing of these fruits into several food products, especially jams, compotes, marmalades and juice 34. According to Sakamura and Suga 35, the majority of fruit sugars are represented mainly by glucose and fructose. According to Ayaz et al 36, the variation of reducing sugar can be attributed to different factors including the ripening stage, the temperature, the duration of exposure to the sun, and weather condition.

Table 2. Total and reducing sugars in Rubus fruticosus.

| Harvesting site | Reducing sugars (mg/l) | Total sugars |
|-----------------|------------------------|-------------|
| BM              | 22.4±2.6               | 27.4±2.67   |
| GH              | 25±2.6                 | 30.3±2.67   |
| HG              | 19.8±2.6               | 25±2.67     |
| Mean            | 22.4±2.6               | 27.43±2.67  |

BM: Beni messaour/ GH: ghezaoua/ HG: Had Gharbia

The obtained results showed that the fruit is acidic in nature, rich in water and total sugars which were represented by reducing and non-reducing sugars.

4. Conclusion

Results of our study showed water content of 70% and a rate of ashes of 4.46±2.17%. Our fruit was acidic and had a pH value of 4.65±0.32, titratable acidity of 5.05±0.66 and TSS of 9.8±0.76%. Also, values for reducing and total sugars were 22.4±2.6 mg/l and 27.43±2.67 mg/l, respectively. This study implies that wild-growing blackberries present an average variation on Physicochemical characteristics. This wild blackberry needs more study in identification and quantification of the bioactive constituents of fruit, seeds, flesh and peel. Also, their influence on human health needs to be discovered. As it has high acidity, it is an important mineral source when compared to the same genus cultivars. Thus, this study contributes to the improvement of scientific knowledge on the native plants of the region.

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**Conflict of Interest**

Authors declare no conflict of interest.

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