

# Testing the Influence of Climatic Conditions on Nutritional Content of some Wild Berries Species from Mărișel Area, Romania

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## Abstract

The present study was conducted in order to identify the influence of specific climatic conditions of the harvesting area on dry matter content of four species of wild berries (*Rubus idaeus* L., *Ribes nigrum* L., *Vaccinium vitis-idaea* L. and *Vaccinium myrtillus* L.), being known the direct proportionality between above mentioned trait and the nutritional value of the plant, harvested from Marisel area Cluj County, in 2020. The results of the study emphasizes that only environmental temperature and precipitation has an influence. The coefficients of multiple correlation between the two above mentioned climatic factors and dry matter emphasize moderate multiple correlations, the strongest ( $R = 0.561$ ) being reported in lingonberry, and the lowest value ( $R = 0.458$ ) in bilberry.

**Keywords:** multiple correlation, rainfall regimen, response areas, temperature.

## 1. Introduction

The potential benefits of fruit consumption in general and berries in particular are traditionally recognized throughout the world. Studies over time have demonstrated that many berry species are valuable sources of phytonutrients that are believed to have preventive effects against a wide range of chronic diseases, many of which are age-related [2, 6].

The national and international interest in food supplements is based on the fact that an adequate and varied diet could provide, under normal conditions, all the nutrients necessary for normal development and ensuring a healthy life, but due to the changes produced in the last

decades in the style of life, many consumers choose to supplement their diet with food supplements, easy to administer and procure (free access, without medical prescription), often from the same food outlets (specialized stores, retail/supermarket networks).

Research in the field, carried out both on human subjects and at the cellular level, has led to results that suggest that a constant consumption of forest fruits is a dietary habit that can be associated with a lower risk of cardiovascular diseases, diabetes, as well as and reducing the risk of associated complications, cancer, and neurodegenerative diseases, etc. [1, 3, 4, 7].

In addition to being a valuable source of vitamins, minerals and dietary fiber, they contain a diversity of secondary metabolites, most of them especially phenolics, which exhibit complex biological activity [8, 9]. A wide range of products are promoted due to their properties: probiotics, antioxidants, stimulants, depuratives/detoxification, diuretics, many food supplements (especially teas) being recommended as adjuvants in conventional therapies, but also for certain scientifically proven effects, maintaining in normal limits of some important parameters: cholesterol, blood pressure or blood glucose. The aim of the present study is to identify the influence of specific climatic conditions of the harvesting area on four species of wild berries (*Rubus idaeus* L., *Ribes nigrum* L., *Vaccinium vitis-idaea* L. and *Vaccinium myrtillus* L.) dry matter content, being known the direct proportionality between above mentioned trait and the nutritional value of the plant.

## 2. Material and Method

In order to carry out the study, meteorological data were collected, which characterize the climatic conditions in the area under study, namely Marisel, Cluj County, Romania, during the vegetation period of forest fruits, April - September 2020, using a specialized database [10]. The climatic indicators considered are: ambient temperature (°C), atmospheric pressure (mmHg), relative atmospheric humidity (%) and precipitation (mm). Arithmetic averages and medians were calculated for each of the climatic factors (because in some cases the variability exceeded the 30% threshold). In order to identify the climatic factors/the climatic factor that has the potential to influence the dry matter content of the berry species studied, the influence of all four stated climatic indicators was tested

with the help of multivariate analysis. Medium and medium to strong intensities were obtained only for the climate factors temperature (°C) and precipitation (mm).

As a result, we went on to highlight their cumulative effect on the dry matter content [9] of the four species of forest fruits, also with the help of multivariate analysis.

The graphic representation of the interrelationships was made using the response surfaces, and by implementing the multivariate analysis, the multiple correlation coefficients, the determination coefficients and the regression lines were calculated.

The STATISTICA v.8.0 program for Windows was used for statistical data processing.

## 3. Results and Discussions

For the atmospheric temperature, an average of the experimental period was recorded equal to (Table 1).

After testing the influence of climatic factors (atmospheric temperature, relative atmospheric humidity, atmospheric pressure and precipitation regime) on the dry matter content of the forest fruits studied in the Mărișel area, Cluj County, it is found that multiple correlations are recorded that have weak and very weak values for all plant species. A very weak multiple correlation ( $R = 0.085$ ) is reported for raspberries, with a very low representativeness (0.7%). A

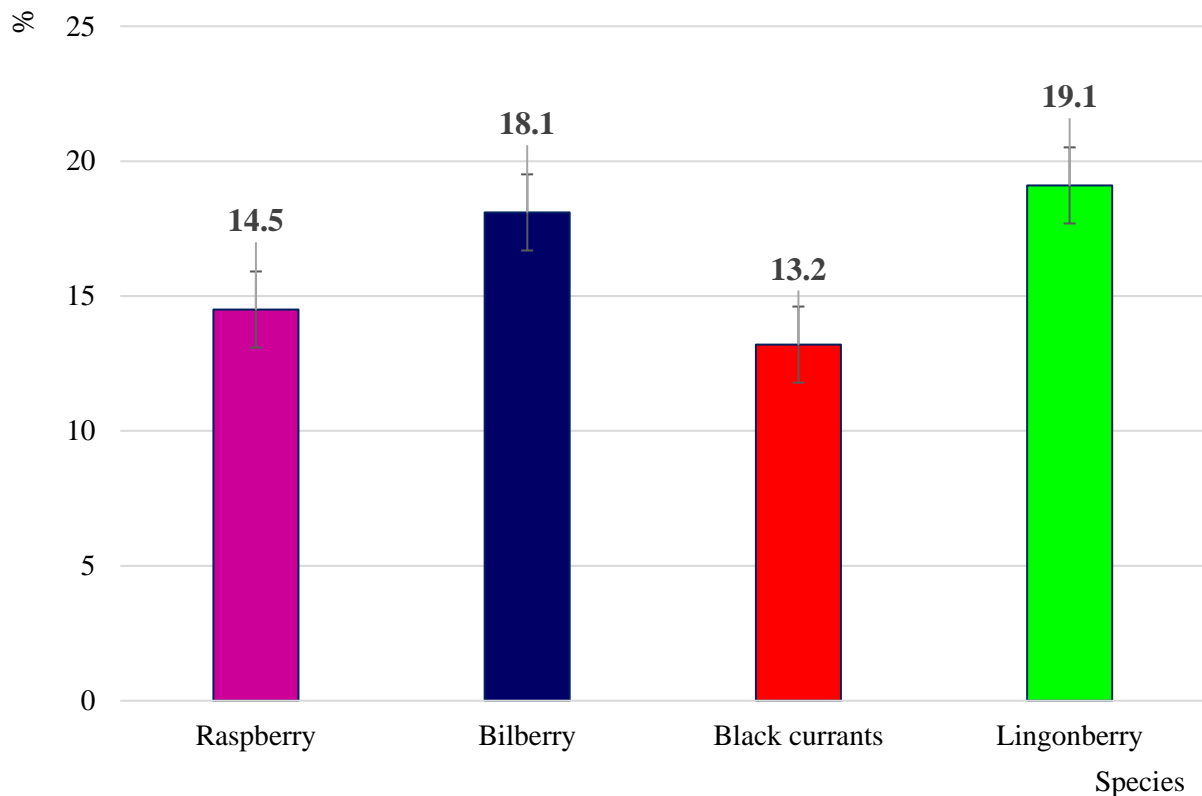
According to the regression line ( $Y = 15.515 - 1.511X_1 - 0.137X_2 - 1.634X_3 + 0.736X_4$ ), in the specific climatic conditions of the Mărișel area, Cluj County, only the increase in the level of precipitation has a positive influence on the dry matter content.

For blackcurrants, a weak multiple correlation is reported ( $R = 0.111$ ), with a low representativeness (1.2%).

**Table 1.** The evolution of the means of the climatic factors temperature (°C), and atmospheric pressure (mmHg) in Mărișel area, from where the studied berry species (bilberry, blackcurrant, raspberry, lingonberry) were harvested in 2020

Month	N	t(°C)	P(mmHg)	RH(%)	Pp (mm)
April	30	5.78	764.12	49.01	12.60
May	31	10.10	761.98	68.03	16.40
June	30	15.59	757.85	76.45	13.80
July	31	16.62	761.59	74.96	24.00
August	31	18.12	724.99	67.70	11.60
September	30	14.11	763.05	70.71	14.80
Mean	-	13.39	755.60	67.81	15.53

N - number of days; t(°C) - mean temperature; p (mmHg) - Mean atmospheric pressure; RH - relative humidity (%); Pp (mm) - rainfall regimen.



**Figure 1.** The evolution of the dry matter content in studied berry species (%) [5]

**Table 2.** The multiple correlations between the climatic factors (temperature, atmospheric pressure, relative humidity, rainfall regimen) and dry matter content of the studied berry species harvested from Mărișel area, Cluj County

Speces	R	R <sup>2</sup>	Regression line
Raspberry	0.085	0.007	$Y = 15.515 - 1.511X_1 - 0.137X_2 - 1.634X_3 + 0.736X_4$
Black currants	0.111	0.012	$Y = 10.956 + 1.371X_1 - 0.063X_2 - 1.349X_3 + 0.551X_4$
Lingonberry	0.102	0.010	$Y = 19.146 + 1.026X_1 - 4.515X_2 - 6.187X_3 + 7.871X_4$
Bilberry	0.115	0.013	$Y = 13.863 + 1.048X_1 + 0.925X_2 + 0.242X_3 - 0.191X_4$

N - number of days; Y - dry matter content; X1 - mean temperature (°C); X2 - Mean atmospheric pressure (mmHg); X3 - relative humidity (%); X4 - rainfall regimen (mm).

According to the regression line ( $Y = 10.956 + 1.371X_1 - 0.063X_2 - 1.349X_3 + 0.551X_4$ ), an increased input of the precipitation level and to a greater extent a superior thermal regime have a positive influence on the dry matter content.

For lingonberries, a weak multiple correlation ( $R = 0.102$ ) is reported, with low representativeness (1%). According to the regression line ( $Y = 19.146 + 1.026X_1 - 4.515X_2 - 6.187X_3 + 7.871X_4$ ), to a greater extent the increased input of the precipitation level and to a lesser extent the upper thermal regime have a positive influence on the dry matter content. For bilberries, a weak multiple correlation ( $R = 0.115$ ) is reported, with a low representativeness (1.3%). According to the regression line ( $Y = 13.863 + 1.048X_1 + 0.925X_2 + 0.242X_3 - 0.191X_4$ ), to a

greater extent the upper thermal regime and to a lesser extent an increase in relative atmospheric humidity and atmospheric pressure have a positive influence on the content of dry matter (Table 2).

Following the individual testing of the influence of each of the climatic factors considered (atmospheric temperature, atmospheric pressure, relative atmospheric humidity and precipitation regime), on the dry matter content of raspberries - *Rubus idaeus* L., blackcurrants - *Ribes nigrum* L., lingonberries - *Vaccinium vitis-idaea* L. and bilberry - *Vaccinium myrtillus* L., by calculating the simple correlations, it is found that, for each harvesting area, only the atmospheric temperature and the precipitation have an average influence (Table 3).

**Table 3.** The multiple individual correlations between the climatic factors (temperature, atmospheric pressure, relative humidity, rainfall regimen) and dry matter content of the studied berry species harvested from Mărișel area, Cluj County

Issue	Atmospheric temperature (°C)		Atmospheric pressure (mmHg)		Atmospheric relative humidity (%)		Rainfall regimen (mm)	
Species	R	R <sup>2</sup>	R	R <sup>2</sup>	R	R <sup>2</sup>	R	R <sup>2</sup>
Raspberry	0.438	0.192	0.098	0.010	0.105	0.011	0.398	0.158
Black currants	0.512	0.262	0.095	0.009	0.112	0.013	0.405	0.164
Lingonberry	0.528	0.279	0.102	0.010	0.115	0.013	0.501	0.251
Bilberry	0.476	0.227	0.105	0.011	0.114	0.013	0.466	0.217

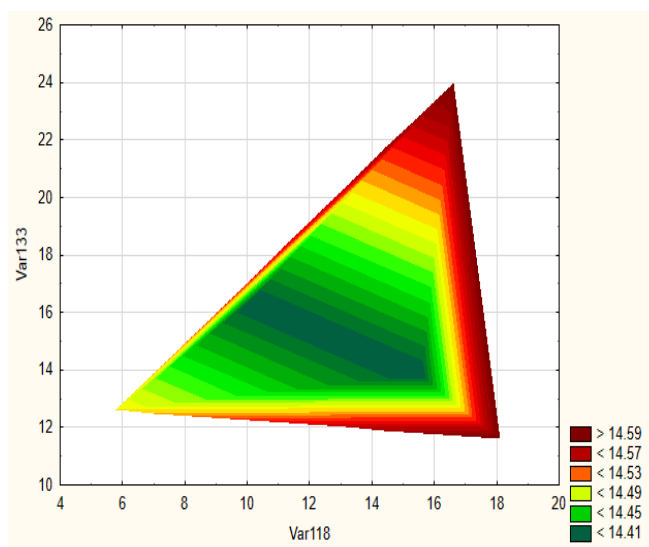
R – correlation coefficient; R<sup>2</sup> – determination coefficient.

The way in which the rainfall and the thermal regime influence the dry matter content of the berry species studied, in the geographical areas from which the harvest was carried out, is shown both by the graphical representations through the response surfaces and through the regression lines.

In the area of Mărișel, Cluj County, average multiple correlations were identified between dry matter content, atmospheric temperature and rainfall, for all species of forest fruits taken in the study, respectively: R = 0.471 (with a representativeness equal to 22, 10%) for raspberries, R = 0.485 (with a representativeness equal to 23.50%) for blackcurrants, R = 0.471 (with a representativeness equal to 31.50%) for lingonberries and R = 0.471 (with a representativeness equal to 20.90%) for

bilberries (Fig. 2). For raspberries, it is found that an accumulation of dry matter of over 14.59% is favored by temperatures in the range t = 14°C – 18°C and a rainfall regime in the range pp = 12 mm – 24 mm (Fig. 2a). For blackcurrants, it is found that an accumulation of dry matter of more than 13.29% is favored by temperatures in the range t = 14°C – 18°C and a rainfall regime in the range pp = 12 mm – 24 mm (Fig. 2b). C

concerning the lingonberries, it is found that a dry matter accumulation of over 19.19% is favored by temperatures in the range t = 12°C – 16°C and a rainfall regime in the range pp = 13 mm – 24 mm (Fig. 2c). For blueberries, it is found that a dry matter accumulation of over 18.19% is favored by temperatures in the range t = 13°C – 16°C and a rainfall regime in the range pp = 11.5 mm – 24 mm (Fig. 2d).

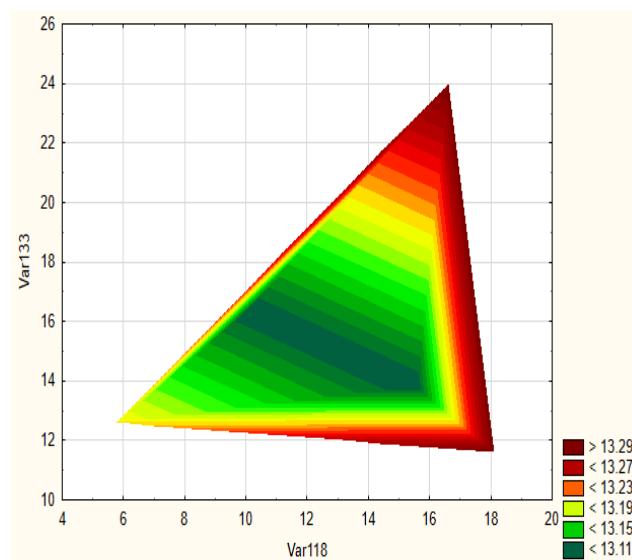


Var 133 – rainfall regimen (mm), Var 118 – temperature (°C)

$$Y = 14.342 + 0.396X_1 + 0.176X_2$$

$$R = 0.471; R^2 = 0.221$$

**a. Raspberry**



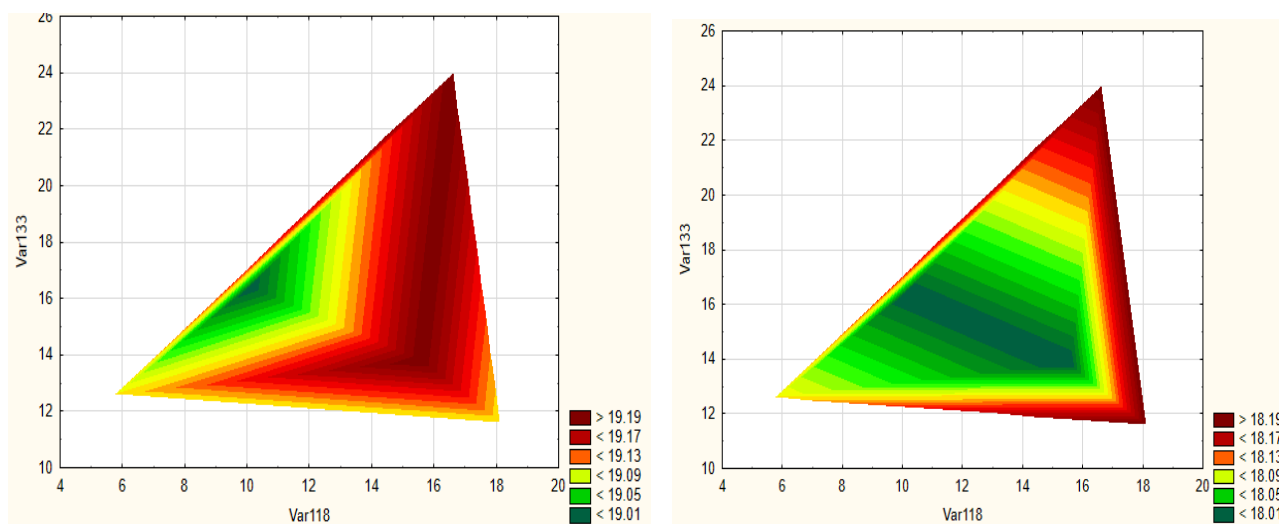
Var 133 – rainfall regimen (mm), Var 118 – temperature (°C)

$$Y = 13.042 + 0.399X_1 + 0.179X_2$$

$$R = 0.485; R^2 = 0.235$$

**b. Blackcurrant**

**Figure 2.** The influence of temperature and rainfall regimen from Mărișel area, Cluj County, on dry matter content in studied berries species



Var 133 – rainfall regimen (mm), Var 118 – temperature (°C)

$$Y = 18.960 + 0.458X_1 + 0.233X_2$$

$$R = 0.561; R^2 = 0.315$$

c. Lingonberry

Var 133 – rainfall regimen (mm), Var 118 – temperature (°C)

$$Y = 17.942 + 0.346X_1 + 0.168X_2$$

$$R = 0.458; R^2 = 0.209$$

d. Bilberry

Figure 2. The influence of temperature and rainfall regimen from Mărișel area, Cluj County, on dry matter content in studied berries species - continued

#### 4. Conclusions

The highest dry matter content is reported in black currant (17.24%), and bilberry (14.9%). The analysis of the influence of the climatic factors upon the dry matter content in studied species emphasizes that only environmental temperature and precipitation has an influence. The coefficients of multiple correlation between the two above mentioned climatic factors and dry matter content in studied wild berries species, which are low or medium, show that black currant ( $R = 0.395$ ), raspberry ( $R = 0.635$ ), and bilberry ( $R = 0.671$ ), are less influenced by them, compared with lingonberry ( $R = 0.940$ ).

Thus, from the point of view of influence of climatic conditions upon their dry matter content, our study emphasizes moderate multiple correlations, the strongest ( $R = 0.561$ ) being reported in lingonberry, and the lowest value ( $R = 0.458$ ) in bilberry.

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