

## Physicochemical characterization of the pseudofruits of strawberry hybrids in northern Minas Gerais



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### ABSTRACT

The strawberry plant is disseminated in a state of the most diverse climatic conditions, it is traditionally

cultivated in the states of the southern region, seeking a better recommendation for the current market where a hybrid breeding experiment was elaborated. Aiming to generate a new pure strain with favorable alleles, present in two or more genotypes, presenting characteristics of the strawberry tree that is desired, such as shape, aroma, flavor, color and properties. Based on these factors, the objective of this work was to perform the physicochemical characterization of pseudofruits of ten strawberry hybrids obtained by hybridization, in order to verify the best recommended cross for the current market. Evaluations of 10 hybrids obtained by the complete diallel system named EP01 to EP10 were carried out, the results were submitted to analysis of variance and used for the test of means, Tukey's test at the level of 5% probability. Thus, obtaining values for determination of soluble solids (SS) content, °Brix, quantification of titratable acidity (TA) of strawberry fruits, and pH values. It should be noted that for the characteristics (SS) the hybrid EP08 presented a higher value of °Brix, the hybrids EP01 and EP03 revealed a higher value of TA, being 3.00% of citric acid in both. For the pH, the hybrids EP02, EP03 and EP08 showed the highest mean values. In the end, it can be concluded that the EP08 hybrid presents physicochemical characteristics of the pseudofruits superior to the other hybrids evaluated.

**Keywords:** Hybridization, Hallelujah x toyonoka, Traits, Genetic improvement.

## 1 INTRODUCTION

The strawberry originates from a hybrid between *Fragaria Chiloensis* that was brought from Chile by Amédée-François Frézier in 1714 with the variety *Fragaria virginiana* from eastern North America. It is a pseudofruit belonging to the family Rosaceae of the genus *Fragaria*. The species *Fragaria x Ananassa* was first bred in Brittany, in the Northwest of France, in the 1750s and is the most commercially cultivated being well developed in countries such as the United States, Spain, Japan,



Italy, South Korea and Poland, being also the most appreciated worldwide. The strawberry plant produces large, fleshy, juicy pseudofruits, with a slightly acidic flavor and has a reddish color in its pulp. (Figure 1).

Figure 1 - Strawberry hybrids produced at EPAMIG Norte - Gorutuba Experimental Field (CEGR), Nova Porteirinha, MG



SOURCE: Authors (2022)

Strawberry is a plant that can be raised in different edaphoclimatic conditions, and temperature is the main variable that influences the crop, altering its vegetative and reproductive performance. The most favorable climate is temperate, but there are cultivars that produce perfectly well in subtropical regions and even in tropical conditions (Makishima & Couto, 1964). In high temperature conditions, flowering is interrupted and the strawberry plant tends to reproduce by vegetative growth, accelerating the production of a large number of stolons. In low temperature conditions, flowering also ceases, however, with the increase in the number of cold hours, the plant starts to store reserve substances (RONQUE, 1998).

In Brazil, the states of Minas Gerais, Paraná, Rio Grande do Sul and São Paulo, are the largest strawberry producers. The advances obtained with genetic improvement have strongly contributed to the adequacy of the crop in the various regions of the world. In this sense, strawberry breeding programs are of great economic importance. In Brazil, there was also an intensification of research to obtain more productive and better quality cultivars (GONÇALVES et al., 2016). The predominant method of genetic improvement of strawberry in Brazil is the hybridization of cultivars, presenting high development and achievement of genotypes, which are separated and classified based on superior phenotypic characteristics, in this way, the classified hybrids can be cloned and submitted, consecutively, to new crosses for better obstinacy of favorable appeals. According to Zawadneak;



Schuber; Mógor (2014) The selected materials can be released into the field in the environmental conditions for which they are intended, as soon as they are tested, and their stability and adaptability are evaluated.

The methods required for the development of pure lines through hybridization are: selection of hybridization parents, F1 generation, conduction of segregating populations, selection of individual plants and evaluation of pure lines in advanced generations. The hybridization methods differ from each other, considering the advancement of generations for the fixation of homozygous genotypes and for the selection of superior pure lines. After the choice of genotypes, the crossing is made in order to gather estimable characteristics in a single organism. Certain properties, such as the total soluble solids (SS) content in °Brix, quantification of titratable acidity (TA) of strawberry fruits and pH, must be considered in order to obtain results with physicochemical characteristics for the development of the local market. Thus, the objective of this work was to analyze the physicochemical properties of experimental strawberry hybrids, in order to verify the best economic viability of the fruit.

## 2 MATERIALS AND METHODS

The experiment was carried out at the facilities of the Gortuba Experimental Field (CEGR) of EPAMIG Norte, in Nova Porteirinha, MG (Latitude: 15° 48' 15" South, Longitude 43° 18' 0" West), at the Biotechnology Laboratory, the climate classification is BSh according to Köppen and Geiger. Seedlings with three definitive leaves, approximately 15 cm long, were planted in 7 L pots and in a greenhouse. Ten hybrids were evaluated, obtained by the complete diallel system, named EP01, EP02, EP03, EP04, EP05, EP06, EP07, EP08, EP09 and EP10. Irrigation was carried out according to need, through visual evaluation and conducted by micro-sprinklers. Fertilization and cultural treatments pertinent to the crop were carried out according to the demand related to the producing region. The determination of the soluble solids (SS) content was by direct reading, in a benchtop digital refractometer (room temperature), thus it was carried out using 10 g of strawberry and 90 mL of MilliQ water, which was dripped in a refractometer, determining the characteristics in percentage of °Brix. (Figure 2).



Figure 2 - Determination of total soluble solids (SS) content



SOURCE: Authors (2022)

Another prepared subsample was used, where the titratable acidity (TA) determined by titration with NaOH solution (0.1 N) was quantified, using phenolphthalein as an indicator, according to the methodology described in AOAC (2012), and the results obtained were expressed in % of citric acid 100 g<sup>-1</sup> of pulp. It was measured with the aid of a Tec-3MP pH meter (Tecnal), according to the methodology described in the Association of Official Analytical Chemists, AOAC (2012). The experiment was carried out in a completely randomized design, consisting of six replications, and the data obtained were submitted to analysis of variance and used for the test of means, Tukey's test, at 5% statistical significance.

### 3 RESULTS AND DISCUSSION

Evaluating the ten hybrids for the SS Content characteristic, it was observed that the EP08, EP06 and EP01 hybrids presented higher °Brix values, with a significant difference when compared to the EP10 hybrid, which presented lower TSS, with an overall average of 7.0 °Brix. (Table 1).

The hybrids EP01 and EP03 showed higher ATT values, with 3.00% citric acid in both, statistically differing from those with lower TA values, such as EP10, EP04, EP08, EP07 and EP05. (Table 2).

It was observed that the EP02, EP03 and EP08 hybrids presented higher mean pH values, statistically different from the EP06, EP05, EP09, EP07 and EP04 hybrids (Table 3).



Table 1 - Mean values for the total soluble solids (TSS) content of ten strawberry hybrids.

Treatment	SS (°Brix)
EP08	9.67a
EP06	9.34a
EP01	9.00a
EP02	8.67from
EP09	8.34abc
EP07	8.34abc
EP03	7.34bc
EP05	7.34bc
EP04	7.34bc
EP10	7.00c

Note: Averages followed by the same letter in the columns do not differ from each other by Tukey's test at 5% probability.

Table 2 - Mean values for total titratable acidity (TA) of ten strawberry hybrids

Treatment	AT (% Citric Acid)
EP01	3.00a
EP03	3.00a
EP06	2.00from
EP09	2.00from
EP10	2.00from
EP04	1.67b
EP08	1.67b
EP07	1.67b
EP05	1.34b
EP02	1.00b

Note: Averages followed by the same letter in the columns do not differ from each other by Tukey's test at 5% probability.

Table 3 - Mean values for the pH of ten strawberry hybrids

Hybrid	pH
EP02	4.00a
EP03	4.00a
EP08	4.00a
EP10	3.67from
EP01	3.67from
EP04	3.00b
EP07	3.00b
EP09	3.00b
EP05	3.00b
EP06	3.00b

Note: Averages followed by the same letter in the columns do not differ from each other by Tukey's test at 5% probability

It is noteworthy that the pH values indicate the stage of ripeness of the fruits, and that those with higher pH are more basic, which indicates a higher ripeness. Guimarães (2009), working with cultivars Oso Grande and Dover submitted to the application of organic compounds to evaluate the properties of postharvest conservation of pseudofruits, found pH values of 3.65 and 3.45, respectively.

## 4 CONCLUSIONS

The results showed that the hybrid EP08 presented physicochemical characteristics of the pseudofruits superior to the other hybrids evaluated, being the most suitable for the Strawberry Genetic Improvement Program.



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