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Article

Grape Varieties for Sparkling Wine Production in Santa Catarina, Brazil: A Study of Phenology, Production, Chemical Composition, and Sensory Evaluation

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Abstract: High-altitude and cold climate regions such as São Joaquim, in Santa Catarina, Brazil, a recent wine-growing region, are characterized by wines with pronounced acidity, ideal for sparkling wine production. The cultivars with potential for producing sparkling wines in this region were unknown. This research evaluates quality sparkling wines from Ribolla Gialla, Riesling Renano, Solaris, Sangiovese, Canaiolo Nero, Chardonnay, and Pinot Noir. The study considered the phenological, productive, and qualitative performance of these varieties in the 2017/2018 and 2018/2019 seasons. Ribolla Gialla, Riesling Renano, and Sangiovese, with later bud break and better productive aspects, are the best viticultural adaptations for the region. Riesling Renano maintains higher acidity. Sparkling wines from Solaris, Chardonnay, and Ribolla Gialla showed the most balanced chemical parameters. Sangiovese produced sparkling wine with the highest aroma intensity and toasted notes. Considering phenological, productive, and qualitative parameters, Riesling Renano, Ribolla Gialla, and Sangiovese are the most promising varieties for sparkling wine production in São Joaquim. Quality sparkling wines can be produced in this region using varieties different from those traditionally used in Brazil, enhancing the diversity of Brazilian viticulture.

Keywords: *Vitis vinifera* L.; titratable acidity; phenolic compounds; sensory analysis; high-altitude viticulture

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1. Introduction

By the end of the 17th century, French winemakers were still grappling with the issue of carbon dioxide bubbles created during fermentation, causing bottles to explode. Subsequently, the increasing preference for these sparkling wines by the British, particularly the royalty, led to the deliberate capturing of bubbles to produce high-quality sparkling wines, largely driven by the Champagne region in France [1,2]. Over time, sparkling wine production was introduced in many regions, including Germany, Portugal, Spain, Italy, South Africa, the United States of America, the United Kingdom, and Brazil. Sparkling wines have proven to be an important product, as it was the only category that recorded an increase in both volume and value [3]. In the world over the past 10 years, sparkling wine production has increased by more than 40%, while still wine increased by only 7% [4]. In Brazil, of the wines sold on the domestic market in 2019, sparkling wine represents the largest portion, with 30.74 million liters sold, a growth of 2.36% compared to the previous year [5].

In Brazil, although the State of Rio Grande do Sul is the main producer of grapes and sparkling wines [6], in the state of Santa Catarina, there is new wine potential. New grape and wine-producing regions are emerging, such as São Joaquim, a municipality located in the Serra Catarinense region in the state of Santa Catarina, Southern Brazil, which has about four thousand hectares and a production of around sixty thousand tons of harvested grapes [5]. This region stands out for viticulture. Located more than 900 m above sea level, it grows cultivars of internationally renowned varieties originating from France, and to a lesser extent, from Italy and Portugal [7].

In recent years, new varieties have been experimented with to produce sparkling wines [8]. In general, the grape varieties for sparkling wine production in Brazil are mainly Chardonnay and Pinot Noir [6]. However, in the Serra Catarinense region, these varieties are early ripening and difficult to cultivate, mainly due to damage caused by late frosts and high rainfall at harvest, causing maturation deficiency [7], that frequently occur in the region. In search of better quality and typicity, alternative varieties have been sought that have greater suitability to different climatic conditions in different regions of the world [9]. Although different factors, such as winemaking technology (aging time) and technological characteristics may affect the composition of sparkling wine, the grape variety used in its production can be considered one of the most important [10,11].

In 2021, the "Vinhos de Altitude de Santa Catarina" indication of origin was granted by the INPI (National Institute of Industrial Property), demonstrating the region's particular characteristics for wine production. Being a recent wine region and the coldest in Brazil, with characteristic vineyards 1000 m above sea level, studies are needed on the possibilities of developing value-added products.

Therefore, this study aimed to evaluate the phenological, productive, and physicochemical characteristics of the Ribolla Gialla, Riesling Renano, Solaris, Sangiovese, Canaiolo Nero, Chardonnay, and Pinot Noir varieties grown in São Joaquim in the Serra Catarinense region, as well as their suitability for the production of sparkling wines according to chemical and sensory quality criteria.

2. Materials and Methods

2.1. Characterization of the Experimental Area

The study was conducted in an experimental vineyard in São Joaquim city, the Serra Catarinense region, Santa Catarina, Brazil. The vineyard is situated at 28°16′ S and 49°56′ W, at an altitude of 1400 m above sea level. The local soil is classified as Humic Cambisol, Litholic Neosol, and Haplic Nitisol, developed from rhyolitic and basaltic rocks [12]. The climate in the region, according to the Köppen classification, is of the Cfb type, mesothermal, humid, without a dry season, and with mild summers (<22 °C) [13].

The monitoring of meteorological conditions was carried out using data from the automatic weather station located at the São Joaquim Experimental Station. The recorded meteorological variables included the average, maximum, and minimum air temperatures (°C); rainfall (mm); and temperature range (°C).

The vineyard was established in 2006 and managed using a single espalier system. The spacing of 3 m between rows and 1.50 m between plants resulted in a density of 2222 plants per hectare. The plants were grafted onto Paulsen 1103 rootstock. The pruning model adopted was the double cordon. Pruning was carried out in the second half of August each year. Fertilization and the treatments were performed as recommended by the technical team of the company.

2.2. Treatments and Experimental Design

The treatments consisted of comparing grape varieties: Ribolla Gialla, Riesling Renano, Sangiovese, Canaiolo Nero, Chardonnay, Pinot Noir, and Solaris (Merzling × Geisenheim 6493), during the agricultural cycles of 2017/2018 and 2018/2019. The experimental design adopted was completely randomized, with five replications, and each experimental unit was composed of ten plants.

2.3. Production of Sparkling Wine

The sparkling wines were produced by the traditional method. Around 30 kg of each grape variety was used. Rotten fruits and berries were removed manually. The grapes were pressed whole, without destemming, in a hydraulic press (200 kPa) for 5 min. SO_2 (50 mg L^{-1}) was added to the must, without the skins, and underwent alcoholic fermentation at 17 °C with *Saccharomyces cerevisiae* yeast (20 g L^{-1}, Perlage BB, AEB) in 10 L glass bottles. The yeasts were hydrated and acclimatized, as recommended by the manufacturer, at 38 °C. Each treatment had three bottles, and the base wines did not undergo malolactic fermentation. Subsequently, the base wines were placed in individual tanks, and received active dry yeast *Saccharomyces cerevisiae* var. *bayanus* (25 g hL^{-1} Fermol RCH, from AEB), fermentation activator (Nutrozim, Ever Intec), and sucrose (24 g L^{-1}), to obtain a pressure of 6 atm. As a clarifying agent, a coadjuvant, based on silicon dioxide in gel form and activated bentonite (20 g L^{-1}, Compactgel, AEB), was added. After mixing, the wines were placed in 750 mL sparkling wine bottles and closed with bidules and crown caps. The bottles were placed horizontally in a temperature-controlled room at 15 °C, where they remained for 120 days for the second fermentation. After this, the bottles were placed in pupitres for 30 days and riddled twice a day until the residues settled in the neck. The bottle neck was frozen in a suitable tank with a hydroalcoholic solution at −25 °C, and then the yeast residues were removed. No expedition liqueur was added, keeping the sparkling wines in the "nature" classification. At this stage, SO_2 correction was also carried out, which was used at a dose of 50 mg L^{-1}. Subsequently, the bottle was closed with a suitable cork for sparkling wine and a cage. The sparkling wines were kept upright, in a dark environment, at a temperature of 14 °C for further analysis.

2.4. Phenological, Grape Quality and Chemical Analyses

Evaluations of variables related to phenological stages were conducted through weekly visual observations after pruning. The onset date of bud break, full bloom, onset of color change, and berry maturity (harvest) were assessed following the classification proposed by Baillod and Baggiolini in 1993 [14]. The bud break onset date was considered when 50% of the buds reached the "green tip" phenological stage, the full bloom date was considered when 50% of the floral caps separated from the ovary base, and the berry color change date (veraison) was considered when 50% of the berries changed color. The maturity period was defined as the harvest date, considering the berry health status (absence of rot) and soluble solids content (17–20 °Brix) [15].

The number of branches and clusters per plant was determined by manual counting at harvest. The bud fertility index was calculated as the ratio between the number of clusters and the number of shoots per plant (cluster shoot). Production (yield) per plant (kg $plant^{-1}$) was obtained by weighing the total harvested clusters per plant. The estimated productivity (t ha^{-1}) was obtained by multiplying production per plant and the number of plants per hectare. The average fresh cluster weight (g $cluster^{-1}$) was obtained by the ratio of production per plant to the number of clusters per plant. The average fresh berry weight (g berry) was determined by weighing 50 randomly selected berries. The average number of berries (un) was estimated by the ratio of the average cluster weight to the average berry weight.

Analyses of the soluble solids content (°Brix), pH, and total acidity (meq L^{-1}) were performed using the must extracted from 100 berries per replication, which were randomly collected at harvest, according to the methodology proposed by the International Organisation of Vine and Wine [16]. The concentration of polyphenols in grape skins was determined by spectrophotometry, as described by Singleton and Rossi (1965) [17], using the Folin–Ciocalteu reagent and gallic acid as standard, with absorbance readings at 760 nm. Sparkling wines were assessed for alcoholic strength, titratable acidity, total polyphenols (mg L^{-1} of gallic acid), and color intensity (420 nm, 520 nm, and 620 nm). The alcoholic strength was determined by distilling 100 mL of a sample and reading the density of the distillate on a hydrostatic balance. Titratable acidity was determined by titrating 5 mL of a sample using bromothymol blue and phenolphthalein for musts and wine, respectively.

2.5. Sensory Analysis

The quantitative descriptive sensory analysis was carried out with approval from the Research Ethics Committee of the State University of Santa Catarina, under Certificate of Presentation of Ethical Assessment nº 87299418.4.0000.0118. Twelve selected and trained panelists participated, comprising 75% men and 25% women, aged between 24 and 63 years old. They used the proposed form, adapted from Meneguzzo (2014) [18], using a non-parametric scale of 9 cm. The sensory evaluation took place three months after bottling the sparkling wines, with samples tasted individually in coded flute glasses containing 50 mL of each sample, and the serving temperature was 8 °C.

The sensory attributes evaluated included color intensity, bubble quality, aroma intensity, floral aroma, fruity aroma, undesirable aroma, vegetal flavor, fruity flavor, acidity, bitterness, persistence, and gustatory quality.

2.6. Statistical Analysis

Descriptive statistical analysis in Microsoft Excel software was conducted for comparing the phenological stages of the varieties. Principal component analysis (PCA) was performed to evaluate the interrelationship between the analyzed variables. Additionally, kmeans clustering analysis was employed to group similar data together and discover underlying patterns or structures. The kmeans results are presented in the same biplot generated by PCA. The multivariate analyses were performed using the statistical software R, version 4.2.2, through the FactoMineR and FactoExtra packages [19].

3. Results

3.1. Phenological Data

There is a similarity between the average annual temperatures (maximum, minimum, and mean) and precipitation during the two years of the study (Figure 1). The 2018/2019 season was characterized by the onset of spring, with higher average temperatures compared to 2017/2018. From August to October 2018, the average monthly temperature was 2.3 °C higher than the equivalent period in 2017 (Figure 1). Overall, there was an average anticipation of 13 days for bud break to begin in the 2018/2019 cycle compared to the 2017/2018 cycle. In both cycles, the thermal amplitude was close to 10 °C.

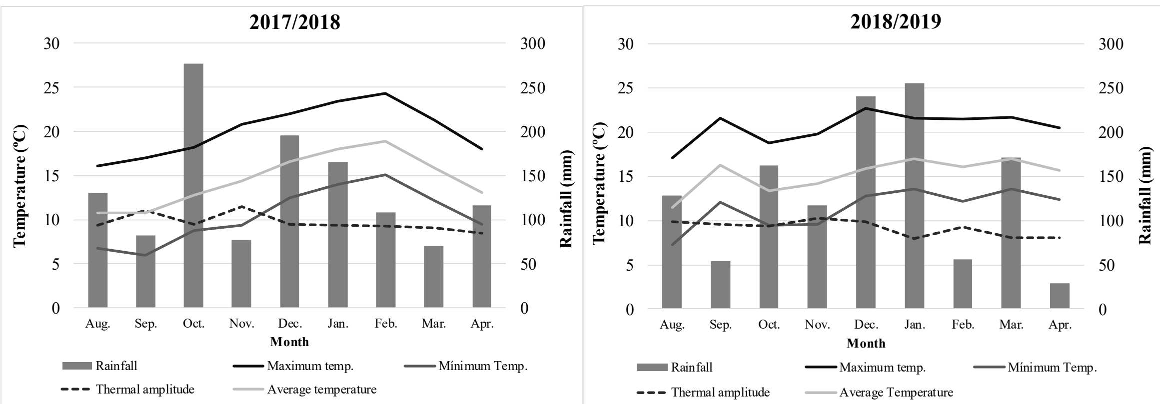

Figure 1. Monthly average of rainfall, average temperature, maximum temperature, minimum temperature and thermal amplitude during the vegetative period of the vine in the high-altitude region of Santa Catarina, Brazil.

It can be seen that the periods with the lowest minimum temperatures are between the months of August and September, with occurrences of frost from the end of winter until spring (Figure 1). It can also be seen that, in February, the temperatures begin to gradually decrease as the summer period comes to an end.

During the months of January to March (the stage of berry color change), there was a concentration of precipitation corresponding to 28.14% and 39.75% of the accumulated annual precipitation for the 2017/2018 and 2018/2019 seasons, respectively. The maturation stage was the phenological period with the highest percentage of rainy days. The highest volume occurred during the 2019 harvest.

The average date of occurrence of events can be seen in Table S1 in the Supplementary Data.

The Figure 2 shows that the average time between the date of bud break and maturity (harvest) of the varieties was 190 days. This period was shorter for the Solaris variety, with an average of only 165 days. The dormancy of the Solaris variety was practically overcome even before the beginning of pruning in the region. Thus, it can be observed that the varieties that sprout earlier are Solaris, Pinot Noir, and Chardonnay, with a budding period still in mid-August and early November.

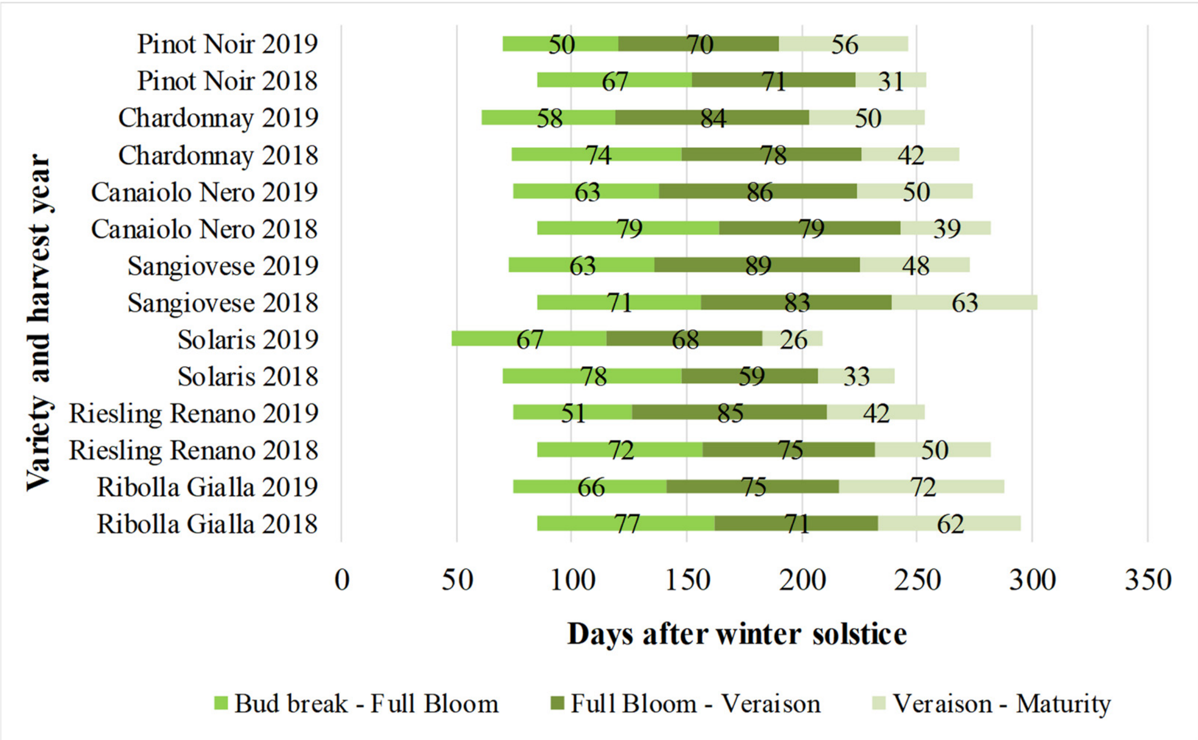

Figure 2. Average duration of phenological stages, counted from the winter solstice, of the studied grape varieties for sparkling wine production in São Joaquim, SC, 2018/2019 harvest.

Furthermore, Solaris, Chardonnay, and Pinot Noir had their full flowering earlier, in mid-October, in the rainiest month of the spring period. Sangiovese, Canaiolo Nero, and Ribolla Gialla had later flowering, in mid-November, in a period of lower rainfall.

Although, with the shortest cycle duration among the evaluated varieties, it has the longest period between the phenological stages of bud break and flowering in both years evaluated. The longest average period was observed for Ribolla Gialla, with a cycle duration of 211 days. On average, Ribolla Gialla and Riesling Renano were the cultivars with the latest bud break among the evaluated cultivars, starting bud break in mid-September. Solaris and Chardonnay budded earlier, with an average date in the first half of August.

Figure 3 shows the principal component analysis of the productive and qualitative data of the studied varieties. The variables with the greatest contribution to the first dimension are the average cluster weight and yield per plant. For the second dimension, the variables fertility index and number of clusters had a greater contribution.

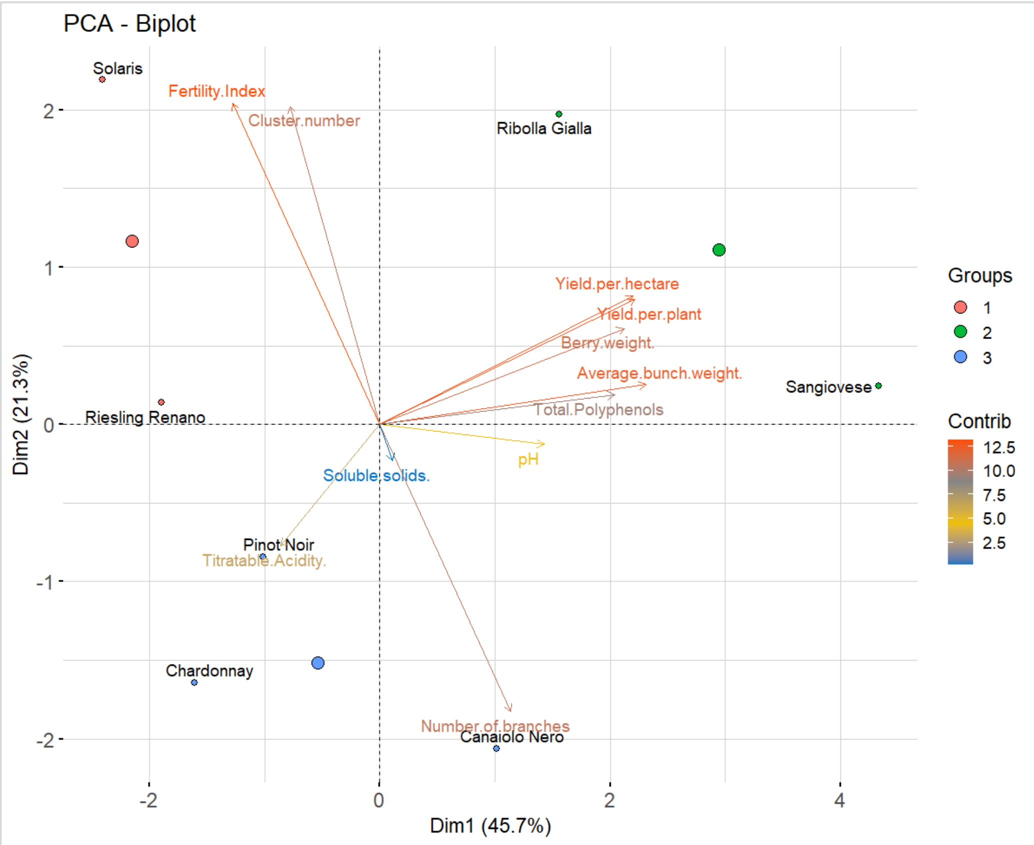

Figure 3. Principal component analysis was conducted using productivity, number of clusters per plant, number of berries, soluble solids, titratable acidity, pH, and total polyphenols of the seven grape varieties destined for the production of sparkling wines.

The kmeans clustering analysis allowed the separation of varieties into three groups:

Group 1, consisting of the Solaris and Riesling Renano varieties, was positioned more to the left of the graph, in the opposite direction of the variables corresponding to the first principal component, indicating that they are varieties with lower yields and average cluster weights than those in group 3. The difference between Solaris and Riesling Renano also occurred due to the second principal component, with the Solaris variety having higher fertility and a greater number of clusters than Riesling Renano.

Chardonnay, Pinot Noir, and Canaiolo Nero are grouped at the bottom of the graph, forming group 2. The difference between group 2 and group 1 is mainly due to the second principal component, with the varieties in group 1 having higher fertility and a greater number of clusters than those in group 2. According to the second principal component, the number of branches was inversely proportional to the number of clusters and fertility. The varieties in group 2 had a higher number of branches than those in group 1.

In group 3, Ribolla Gialla and Sangiovese were positioned in the direction and sense of the variables with the greatest contribution to the first principal component, meaning that group 3 consisted of cultivars with higher yields and average cluster weights. The difference between Ribolla Gialla and Sangiovese was due to the variables of the second principal component, with Ribolla Gialla having higher fertility and a greater number of clusters than Sangiovese.

The average data from the production analysis variables obtained from these cultivars can be found in Table S2 of the Supplementary Materials.

3.2. Chemical Analysis of Sparkling Wines

Figure 4 shows the results of the principal component analysis of the mean chemical analysis of the sparkling wines made with the evaluated varieties from the two harvests. The average results of the physicochemical analyses can be seen in Table S3 of the Supplementary Materials. It is observed that there is differentiation among the varieties in the chemical composition of the sparkling wines.

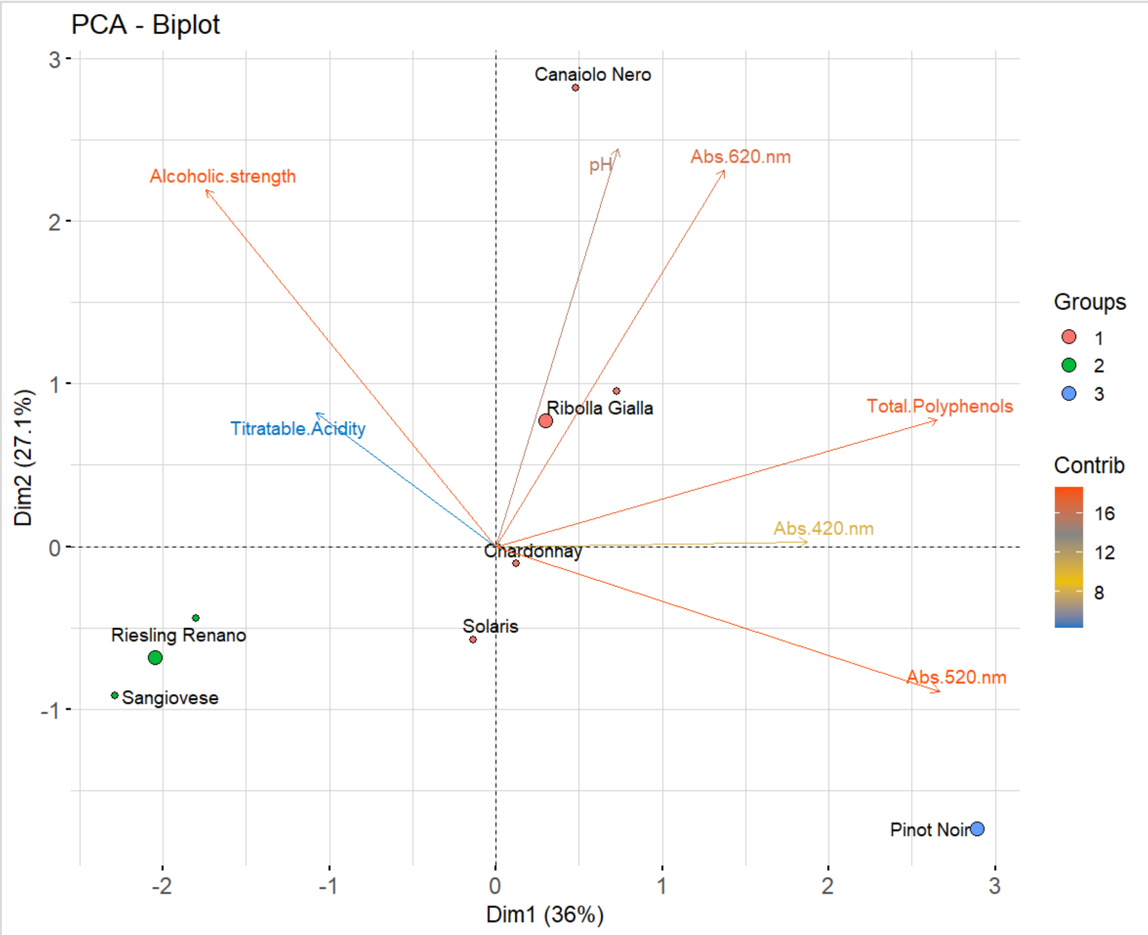

Figure 4. Principal component analysis of the chemical variables of sparkling wines produced from seven grape varieties intended for the production of sparkling wines, harvested in 2018 and 2019 in São Joaquim, SC.

It can be observed that the variables contributing most to the first dimension are the absorbance at 520 nm (red color intensity) and total polyphenols. In the second dimension, pH, absorbance at 620 nm (blue color intensity), and alcoholic strength stand out.

The main difference between the three groups formed by kmeans clustering analysis is related to the first principal component. Riesling Renano and Canaiolo Nero were the sparkling wines that resulted in the highest titratable acidity among those evaluated.

The amount of total polyphenols and red color intensity decreases from group 1, group 2, to group 3. Thus, Pinot Noir was the variety with the highest level of total polyphenols and greatest red color intensity. It is observed that, although Sangiovese had a high amount of polyphenols in the must, it was not as stable throughout the process, as can also be seen in the color analysis of the sparkling wines.

The sparkling wines produced with the cultivars Solaris, Chardonnay, and Ribolla Gialla are centralized in the graphic in relation to their chemical attributes, demonstrating intermediate quantities of the attributes in relation to the other cultivars.

Regarding the second principal component, the Canaiolo Nero cultivar stands out with the highest alcohol content, pH index, and blue color intensity. Compared to Pinot Noir, which has the lowest alcohol content, the Canaiolo Nero cultivar is 16.9% higher than Pinot Noir.

3.3. Analysis of Sensory Attributes

The principal component analysis shows the separation of sparkling wines based on sensory analysis into three groups (Figure 5). One group contains of the Sangiovese variety and a second group contain the Chardonnay and Canaiolo varieties.

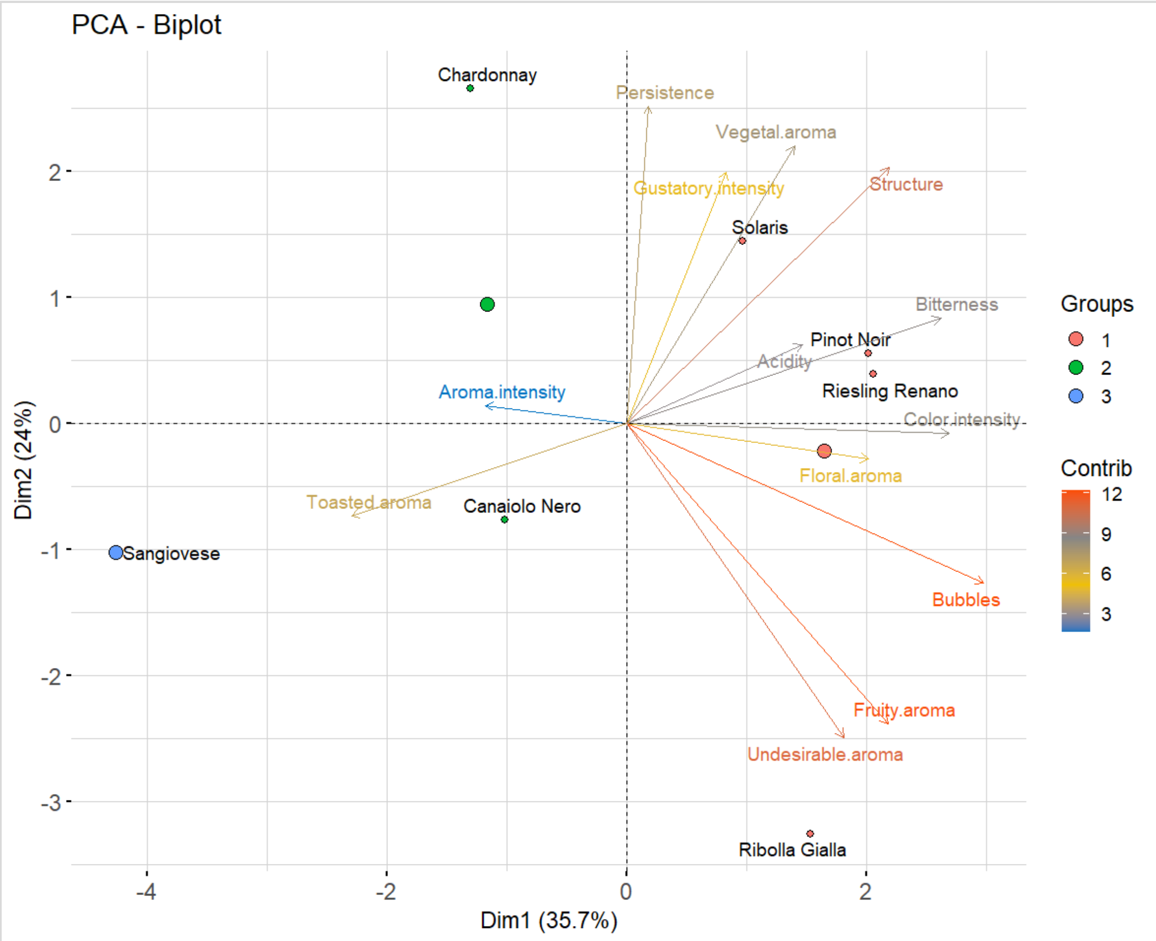

Figure 5. Principal component analysis of the sensory analysis of sparkling wines, harvested in 2018 and 2019 from São Joaquim, SC.

Most of the evaluated attributes are on the right, along with the first group, composed of sparkling wines from the Solaris, Pinot Noir, Ribolla Gialla, and Riesling Renano varieties. The sparkling wines produced with these varieties were classified by the panel as those associated with greater bubbles, color intensity, bitterness, and structure.

The sparkling wine produced with the Sangiovese variety appears on the left side of the graph, indicating it has the highest level of toasted aroma compared to the other sensory attributes. Most of the evaluated attributes are on the right (third group), that is, the Solaris, Pinot Noir, Ribolla Gialla, and Riesling Renano varieties. The sparkling wines produced with these varieties were classified by the panel as those associated with greater bubbles, color intensity, bitterness, and structure.

The scores obtained for the sensory analysis of sparkling wines can be seen in Table S4 of the Supplementary Materials.

4. Discussion

Understanding phenological stages is a requirement of modern viticulture, as it allows for the rationalization and optimization of cultural practices, which are essential for vine cultivation [20]. Adaptation strategies, such as the search for varieties, harvest management, and winemaking technologies, must deal with the effects of climate change in different locations [21]. Although phenological responses vary for each variety, bud break and flowering stages are the most affected in terms of advancement due to temperature increases [21].

Chardonnay, Solaris, and Pinot Noir are considered to be early budding. The chilling required to overcome endodormancy varies according to species cultivars [22]. Their early budding can be explained because they are cultivars that require shorter chilling hours (CH), such as Chardonnay. According to Anzanello, Fialho, and dos Santos [23] in a study carried out in Serra Gaúcha, Chardonnay requires 150 (CH). These early budding cultivars are more susceptible to damage from late frosts, which are common in high-altitude regions [4].

Cultivars that mature in March and April, such as Sangiovese and Ribolla Gialla, are successful in developing bunches, with the possibility of being able to complete their maturation outside the rainy season, allowing for greater yields.

Generally, the number of degree days is related to local temperatures and the vine cycle interval. As average air temperature increases, the range of phenological sub-periods tends to decrease [24]. Cold nights associated with hot daytime temperatures lead to lower pH values and higher acidity at harvest compared to hot days and warm nights [2].

The degradation of acids in berries during ripening depends on the cultivar and the environment. In this sense, cultivars that can maintain higher levels of acidity are required and valued for the production of sparkling wine [25]. This provides freshness and longevity to the product. This effect can be enhanced due to cold conditions when acid degradation is slower [26], such as for the Riesling Renano, Chardonnay, and Canaiolo Nero cultivars.

The duration of the Ribolla Gialla cycle is the longest among the evaluated varieties. The duration is longer than that observed in a study by Degano et al. (2018) [27], with the same variety in the Friuli region, Italy, with an average of 150 days. Brighenti et al. [7] (2013) found that the duration from bud break to grape ripening is longer in the municipality of São Joaquim and in high-altitude regions than in other regions of Brazil and even worldwide. In Degano et al.'s study (2018) [27] in the Friuli region, Italy, a duration of 52 days was observed between the color change and harvest of the Ribolla Gialla variety. According to Abe et al. (2007) [28], this phase can last from 30 to 70 days, depending on the variety, rootstock, and cultivation region.

In relation to productive aspects, cultivars that have their full flowering in mid-October and early November, such as Chardonnay, Pinot Noir, and Renano Riesling, result in lower productivity. This can be explained by the greater rainfall during this period, causing a lack of fruit set [29].

The greater fertility of buds of the Solaris variety can be explained by the greater number of bunches per plant. However, the Solaris variety showed lower production per plant. The plant needs a vegetative–productive balance between the fruit load (sink) and adequately illuminated leaf area (source), which influences the quantity and quality of production [29,30]. Furthermore, other factors may have an influence in this case, such as light, temperature, precipitation, nutritional factors, and the response of the cultivar itself [26].

For sparkling wines, grapes with higher acidity and lower pH values are required compared to table wines [26,31]. Varieties that ripen in January, such as Solaris, Pinot Noir, and Chardonnay, are considered to have compact clusters, and the occurrence of precipitation during this period makes them susceptible to fungal infections, such as *Botrytis cinerea* [32,33]. Fungal infections in the clusters result in early grape harvesting, making it difficult to balance sugar concentration, titratable acidity, and pH [34,35].

The highest concentration of total polyphenols, found in the Sangiovese variety, can be attributed to it being a characteristic of red grapes—in which there is a greater abundance of these compounds [26]—and also due to its harvest time, which occurs in mid-April, allowing for more complete maturation in chemical terms, as occurred in 2019 with less rainfall.

Due to their harvest occurring in March, cultivars such as Riesling Renano and Canaiolo Nero are able to complete their maturation so that their sugar levels can advance, allowing for a moderate alcohol content. The concentration of soluble sugars, total acidity, and pH are the main quality criteria used to determine the harvest date for grapes used for sparkling wine production and, thus, to determine wine quality [2,36]. Maintaining titratable acidity is a key characteristic of grapes intended for sparkling wine production, as it contributes to the organoleptic quality of the beverage [36].

In relation to sensory attributes, the polyphenols in wines are important, as they contribute to color, body, astringency, and aroma. Considering that all samples of grapes went through the same pressing and processing, the Pinot Noir cultivar had the highest concentration of red color due to the higher levels of phenolic compounds in its skin, [26] which correlated with the higher values of color intensity. The greater structure for sparkling wines produced with Pinot Noir also can be explained by the higher polyphenol content in the sparkling wine.

It is known that the traditional method highlights the quality of bubbles mainly due to mannoproteins in contact with the sparkling wine. Knowing that the process was the same for all cultivars, a greater quantity of bubbles, color, and structure can be attributed to the sparkling wines produced with Pinot Noir, Ribolla Gialla, and Riesling Renano due to the effects of the cultivar itself [2], higher protein content [11], and degree of grape ripeness.

In relation to sparkling wines produced with the Chardonnay and Canaiolo Nero cultivars, because they are in the center of the graph, it is observed to be in the sensorial aspect of balance (harmony). This denotes the perceptual balance of all olfactory and wine sensations, where individual perceptions do not dominate [37].

Meanwhile, the toasted, fermented, and aged aromas in sparkling wines come from the aging time on lees of sparkling wines produced by the traditional method, a process that is slow, expensive, and related to quality [8]. The autolysis of the yeasts that produce the sparkle supplies the toasty scent that characterizes most sparkling wines [37]. The greater amount of the toasted aroma in a sparkling wine produced with Sangiovese can be attributed to a lower predominance of other aromas, since all sparkling wines remained in contact with yeast for the same period.

5. Conclusions

The Sangiovese and Ribolla Gialla cultivars resulted in the latest harvests, with better productivity and higher total polyphenol contents, while Riesling Renano preserved higher acidity.

The sparkling wines produced with Solaris, Chardonnay, and Ribolla Gialla were the most balanced in terms of chemical parameters.

The Sangiovese cultivar produced sparkling wine with the highest intensity of aroma and toasted notes using the traditional method.

Thus, considering the phenological, productive, and qualitative parameters, Riesling Renano, Ribolla Gialla, and Sangiovese are considered the most interesting cultivars for sparkling wine production in the high-altitude regions of Serra Catarinense.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/beverages10030082/s1, Table S1: Average date of occurrences of the main phenological stages of cultivars for sparkling wine production in São Joaquim, Santa Catarina, Brazil, season 2017/2018 and 2018/2019; Table S2: Averages of productive parameters of grape cultivars for sparkling wine production in São Joaquim, Santa Catarina, Brazil, season 2017/2018 and 2018/2019; Table S3: Averages of chemical parameters of sparkling wines produced with grape cultivars in São Joaquim, Santa Catarina, Brazil, season 2017/2018 and 2018/2019; Table S4: Average values of sensory parameter scores of sparkling wines produced with grape cultivars in São Joaquim, Santa Catarina, Brazil, season 2017/2018 and 2018/2019.

Author Contributions: Conceptualization, A.T.C., A.F.B. and D.A.W.; methodology, A.F.B. and L.R.; software, L.R. and D.P.R.; validation, A.F.B. and L.R.; formal analysis, D.P.R.; investigation, A.T.C.; resources, L.R. and A.F.B.; data curation, D.P.R.; writing—original draft preparation, A.T.C.; writing—review and editing, D.A.W., A.F.B. and L.R.; visualization, D.A.W. and A.F.B.; supervision, L.R. and A.F.B.; project administration, L.R.; funding acquisition, L.R. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The original contributions presented in this study are included in the article and Supplementary Materials. Further inquiries can be directed to the corresponding authors.

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