

A BIOCHEMICAL STUDY ON THE *VACCINIUM MYRTILLUS*, *RIBES RUBRUM* AND *RIBES NIGRUM* FRUITS FROM THE SPONTANEOUS FLORA

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Abstract: The paper develops a biochemical study on the content of glucides, vitamins and provitamins, playing the part of antioxidants and, respectively, of organic acids in the fruits of *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* from the spontaneous flora of the Suceava county. The results obtained evidence a significant concentration of all biochemical parameters under analysis, glucose and fructose representing the most important fractions out of glucides, while - out of vitamins - the ascorbic acid attains the highest levels, especially in the *Ribes nigrum* species, which evidence the major antioxidant capacity of the forest fruits.

INTRODUCTION

From ancient times and even today, plants have represented the basis of human alimentation, fruits and seeds having always had a special position, being consumed as food, desert or drugs (SEGAL, 1983).

The history of plants utilization in the treatment of certain affections coincides with the progress of the human society. Naturist medicine has evolved at pace with science, the researches having always attempted at obtaining new, increasingly efficient drugs from plants, known as representing the main sources of active principles.

Forest fruits are especially important in phytotherapy, if considering first their exceptional nutritive qualities. To this category there also belong some species from the *Ribes* and *Vaccinium* genera, their main role being a trophic one, as their fruits are consumed under various forms.

In the traditional Romanian medicine, species from the *Ribes* and *Vaccinium* genera are used in the treatment or melioration of certain maladies in the form of tincture, decoct, syrup, tea, alcoholic drinks; also, their fruits may be consumed either fresh or conserved.

The nutritive qualities of the fruits belonging to these species made them indispensable in the alimentation of the people from the regions in which they grow, as assuring a balanced diet (SEGAL and SEGAL, 1981). Fruits, generally, and the forest ones, especially, have a plastic and energetic role, due to the various substances they contain, necessary for the human organism, involved in the development of various biological processes, *via* their enzymatic and hormonal substances, vitamins and microelements, thus contributing to a rational feeding regime (BĂDESCU *et al.*, 1984; IFRIM, 1997).

At the same time, forest fruits contain numerous principles with bioactive properties, among which special mention should be made of a significant antioxidant activity, induced by the presence of the ascorbic acid, vitamin E, provitamins A, as well as of flavonoids and of other phenolic compounds (BARBERAN and ROBINS, 1997; DEJICA, 2001).

Nevertheless, the utilization of fruits as “drugs” is not recommended in the case of severe affections, which require an adequate medication, yet the substances contained in such plants may prevent some maladies or may significantly contribute to their melioration - which may be explained by the synergic action of the various natural substances, known as highly assimilated by the organism, their action influencing positively not only the affected organ or system of organs, but also the whole organism (WATSON, 2001).

The experimental determinations referred to the separate quantitative dosing of the reducing mono- and oligoglucides, on one hand, and of glucose, fructose and saccharose - on the other, as the main products of glucidic nature, of vitamins C, B₆ and P, of provitamins A, as well as of total acidity and of the citric acid concentration in the three forest fruit species from the spontaneous flora here analyzed.

MATERIALS AND METHOD

The experiments were performed on fruits from three forest bush species, namely *Vaccinium myrtillus* (bilberry), *Ribes rubrum* (red currant) and *Ribes nigrum* (black currant).

Quantitative dosing of such principles in the forest fruits collected from their natural area (the Suceava county) was made on five parallel samples, for avoiding any possible errors and for attaining an as high as possible

reproducibility of the experimental results, if considering that, although picked up during their ripening period, the extent of bushes shadowing was different.

Total glucides and glucose were dosed by the titrimetric method, with the tartro-cupric reactive, as they have the capacity of reducing, at warm, the copper present in the soluble tartro-cupric complex, with the formation of a cuprous oxide precipitate directly proportional to the amount of reducing glucides. Saccharose was dosed by the same method, after a previous hydrolysis of the vegetal extract under the action of chlorhydric acid, while fructose was dosed by the colorimetric method, in an acid medium, where it was transformed into a hydroxymethylfurfural which reacts with resorcline, giving a cherry-colored, red compound whose color intensity is directly proportional with the amount of fructose from the solution. Vitamins C, P and B₆ were dosed by titrimetric methods with potassium iodate, potassium permanganate and with the Folin-Ciocalteu reactive, respectively, the carotenes - by the colorimetric method, with petroleum ether as compensation liquid, while total acidity and citric acid - by the titrimetric method with sodium hydroxide (ARTENIE and TĂNASE, 1981; COJOCARU *et al.*, 2000; ARTENIE *et al.*, 2008).

RESULTS AND DISCUSSION

Forest fruits have a special alimentary importance, as due to their high content of soluble glucides, vitamins, organic acids and insoluble dietetic fibers. The literature of the field (ZHAO, 2007) evidences a certain ratio among the amount of total glucides, glucose, fructose and saccharose, some equilibrium being observed between total acidity and sugar concentration, so that, due to this property, the forest fruits may be consumed either fresh or conserved.

Analysis of the experimental results on the content of total glucides in the fruits from the three bush species under study (Fig. 1) evidences a high level of sugars, the highest concentration being registered in *Ribes rubrum* (with an average value of 11.626 g/100 g fruits), followed by *Vaccinium myrtillus* (9.798 g/100 g fruits) and *Ribes nigrum* (7.582 g/100 g fruits), respectively.

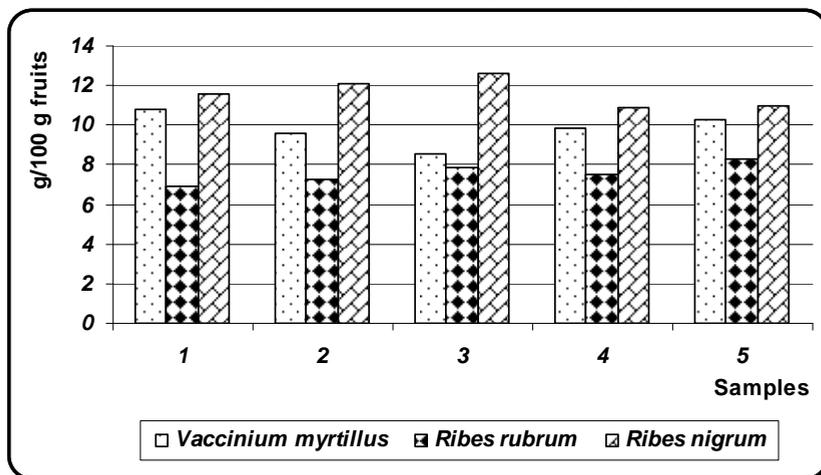


Fig.1. Total glucides concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

There followed the separate determination of the glucose, fructose and saccharose concentration, literature data (ZHAO, 2007) evidencing a certain equilibrium among these saccharides, glucose and fructose having the highest ratio (about 80 - 90% of the whole amount of sugars), while saccharose would attain a lower ratio, of only 10 - 20%.

The results of the present investigation (graphically plotted in Figs. 2 to 4) put into evidence the correlation among the concentration of glucose, fructose and saccharose, the first

two ones attaining the highest ratio of all total glucides (about 90% of the total value), while saccharose occurs in quite low amounts (about 0.7 - 0.9% of the total value of sugars). At the same time, mention should be made of the variation in the glucides content in all species under analysis, higher values being registered for glucose in *Vaccinium myrtillus* (4.616 g/100 g fruits), and for fructose in the case of *Ribes rubrum* (3.678 g/100 g fruits) and *Ribes nigrum* (5.496 g/100 g fruits), respectively.

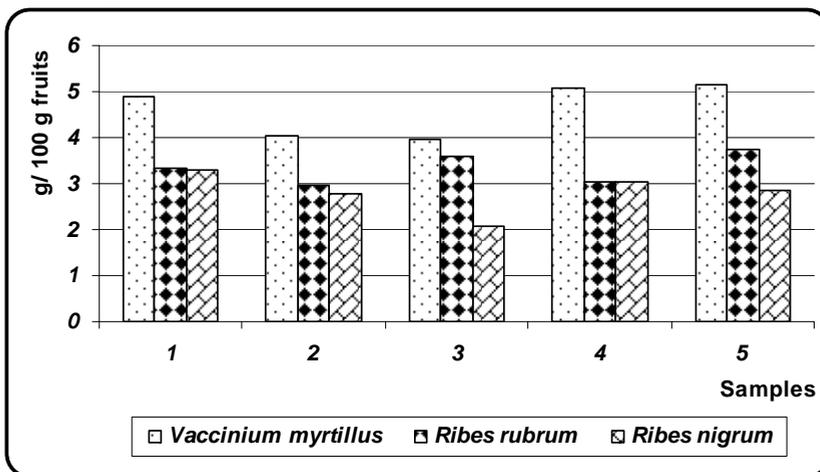


Fig.2. Glucose concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

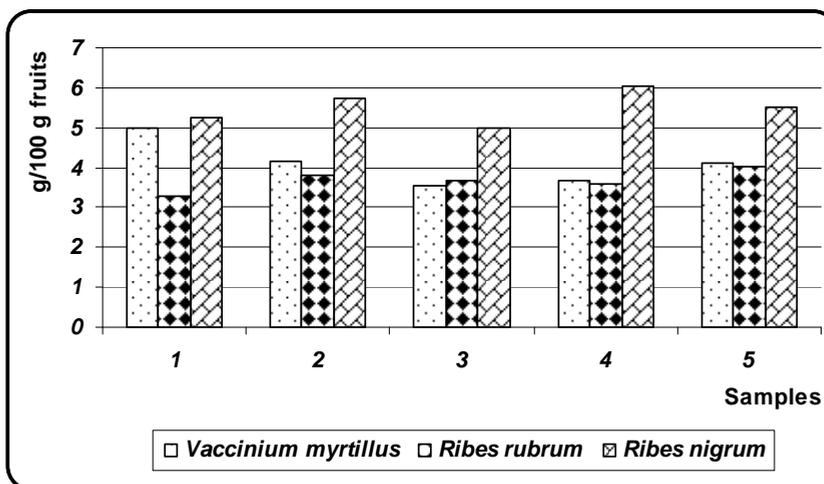


Fig.3. Fructose concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

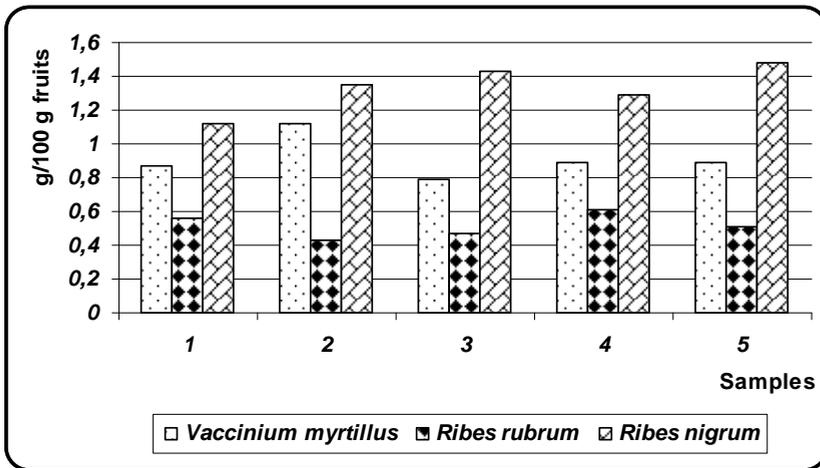


Fig.4. Saccharose concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

The high content of vitamins and mineral substances of the fresh fruits recommend them in the treatment of hypovitaminoses and avitaminoses, of infections diseases of any type, of nervous system affections, for stimulating the immunity system, and as an alimentary supplement during convalescence, against stress, over-exertion and insomnia.

Vitamin C is one of the most well-known antioxidants from fruits and vegetables, being viewed, first of all, as a chemo-preventive agent, protecting the cell against the oxidative stress, through neutralization of the free radicals and of the reactions of lipidic peroxidation.

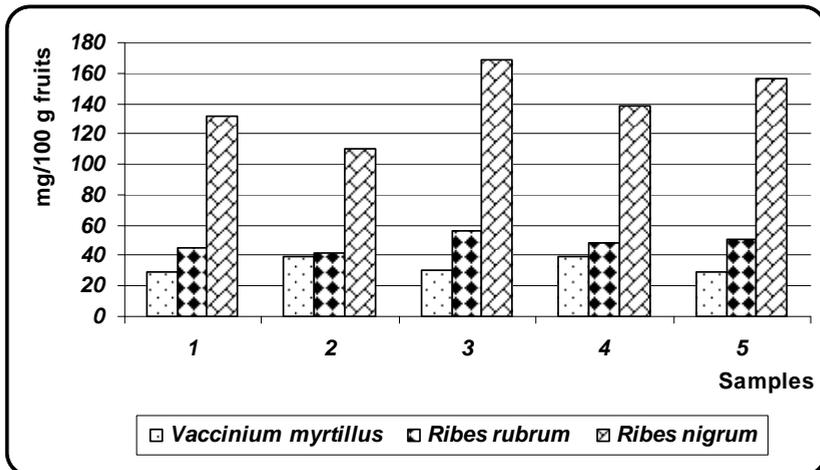


Fig.5. Ascorbic acid concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

Both the bilberries and the currants represent very rich sources of vitamin C, which they maintain in a stable state (due to antocyanins) and in a biologically-active form, as they do not

contain the ascorbate-oxidase enzyme, which inactivates vitamin C, transforming it into dehydroascorbic acid.

The forest fruits here under analysis are very rich in vitamin C, the highest ratio being recorded in the *Ribes nigrum* species (141.22 mg/100 g fruits), while the minimum value (33.5 mg/100 g fruits) was found in the *Vaccinium myrtillus* species (Fig. 5), our results agreeing with those given in the literature of the field, namely a lower vitamin C content in the bilberry (BECEANU, 2008) and a much higher one especially in the black currant, where it varies between 65 and 200 mg/100 g fruits (ZHAO, 2007).

Pyridoxine performs several biochemical and physiological functions, such as: it represents the precursor of pyridoxal-phosphate, it stimulates the biosynthesis of immunoglobins (antibodies), it intervenes in the biosynthesis of hemoglobin and “watches” a correct functioning of the brain, once it is involved in the production of its chemical messengers (dopamine, serotonin), which are essential in nervous coordination, occurrence of thoughts and emotions.

At the same time, it favors the formation of antibodies and increases resistance to infections, it prevents nervous disorders and muscular spasms, it treats the premenstrual syndrome, reduces the risk of renal calculi, as well as the frequency and intensity of asthmatic crises (COJOCARU *et al.*, 2009).

Pyridoxine occurs in quite appreciable amounts in the food of vegetal origin, the best sources being integral wheat flour, brown (non-husked) rice, fresh vegetables, bananas, avocado, green bean, radishes, soya, as well as forest fruits.

Figure 6 illustrates the variable content of B₆, the red currant being the richest of all the three species (0.084 mg/100 g fruits), as to the content of pyridoxine.

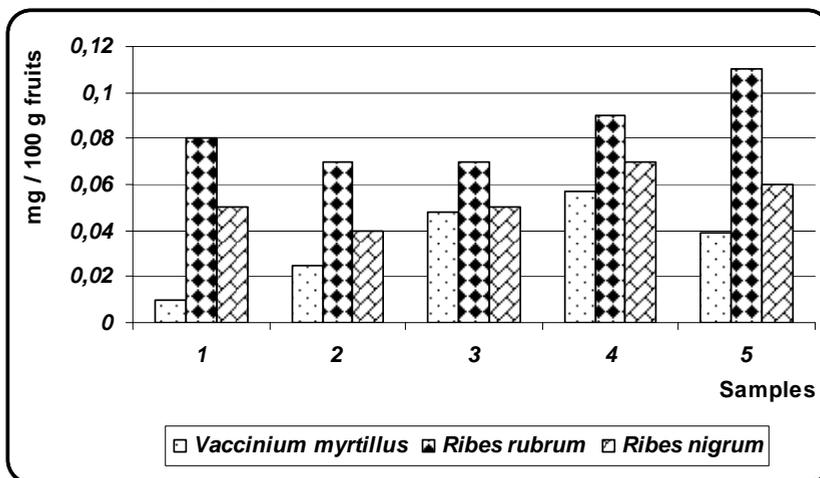


Fig.6. Pyridoxine concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

Flavonoids are quite frequently present in plants, especially in their flowers and fruits, being involved in their pigmentation (as antocyanins, flavonols, flavones and others), as well as in some redox processes developed at the level of the vegetal cell.

The experimental results obtained evidence somewhat higher concentrations of vitamin P in bilberry fruits (9.976 mg/100 g fruits), followed by the red currant fruits (8.024 mg/100 g

fruits), while lower values are registered in the black currant fruits (5.306 mg/100 g fruits) (Fig.7).

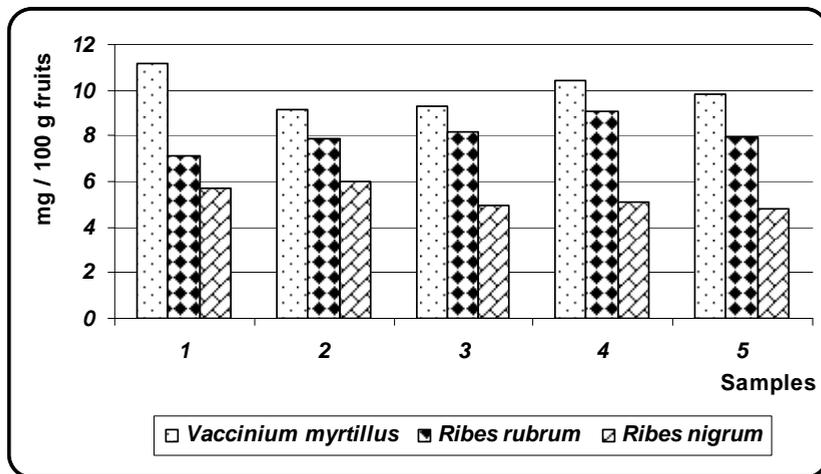


Fig.7. Vitamin P concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

Another objective of the present investigation was dosing of provitamin A, carotenoids presenting some extremely important antioxidating properties, once they are capable of neutralizing the “singlet” oxygen, thus considerably diminishing the risk of cancer, by protecting the epithelial tissues against the free radicals (PICARD, 2008).

Carotenes concentration in the forest fruits (Fig. 8) is highly oscillating from one species to another, the highest values being recorded in *Vaccinium myrtillus* (6.532 mg/100 g fruits), followed by *Ribes nigrum* (3.892 mg/100 g fruits) and *Ribes rubrum* (1.068 mg/100 g fruits).

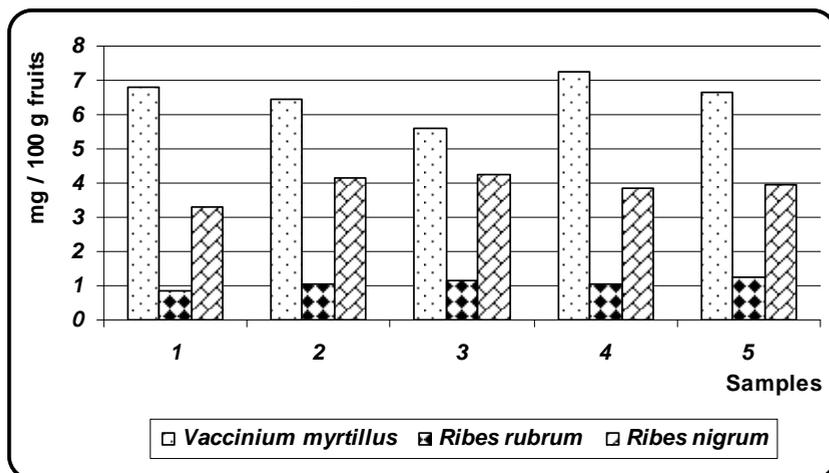


Fig.8. Carotenes concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

As known, forest fruits have a high content of organic acids, represented mainly by the malic acid, citric acid and tartaric acid, which makes them extremely appreciated among the other fruits, due to their slightly-sour taste and special flavor. The rich content of citric acid transforms them into a real aliment - drug for stomach and liver affections, the effects of the organic acids being, probably, more important than that of other minerals or vitamins present in fruits.

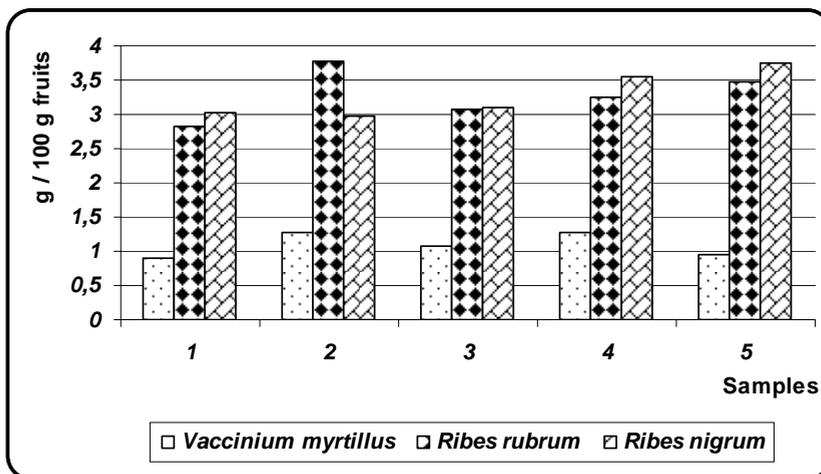


Fig.9. Total acidity in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

Analysis of the total acidity spectrum and, respectively, of the citric acid, permits the observation that, on one hand, it evidences a similar aspect for all three species under investigation and, on the other, that the citric acid attains an extremely high ratio of the whole amount of organic acids present in fruits, namely of 62.2% in the bilberry, 59.6% in red currant and 83.84% in black currant, respectively (Figs. 9 - 10).

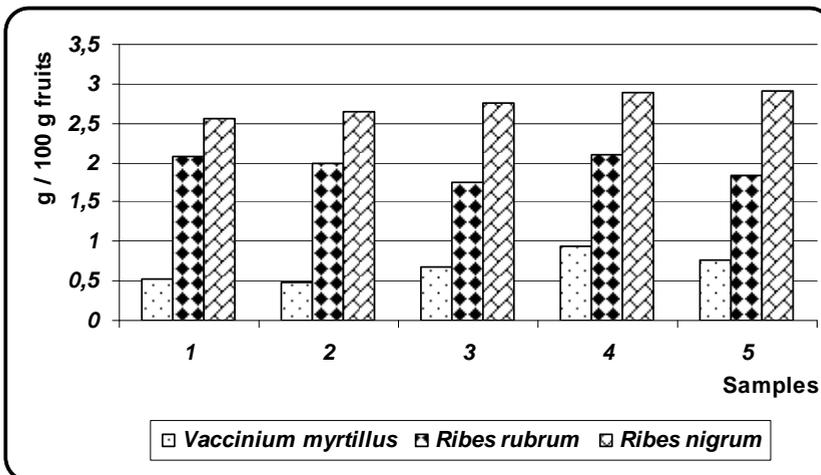


Fig.10. Citric acid concentration in *Vaccinium myrtillus*, *Ribes rubrum* and *Ribes nigrum* fruits

CONCLUSIONS

The results obtained on the concentration of sugars, vitamins and organic acids in the forest fruits here analyzed permitted drawing of the following general conclusions:

Glucides concentration is quite significant in both bilberry and currant, in spite of some differences recorded from one species to another, glucose and fructose - considered together - being of majority.

The forest fruits considered in our study show an important content of vitamins and provitamins, which explains the special part they play in nutrition, in the activation of various enzymatic and hormonal processes, as well as in antioxidative protection, as due to the presence of the bioactive principles.

For all three bush species, high amounts of organic acids have been evidenced, citric acid attaining the highest ratio, while an almost constant balance could be established between total acidity and sugar concentration.

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