

MACARONS WITH BEETROOT, HIBISCUS, ROSES, GREEN SPIRULINA AND COENZYME Q10

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REVIEW, RESEARCH ARTICLE

Abstract

Desserts and sweets are the kids' favorite part of the meal, that is why we improved a very popular dessert, which is adored all over the world – Macarons, by making it rich in amino acids, polyphenols, flavonoids and with an impressive antioxidant effect. Natural pigments from beetroot, hibiscus and green spirulina were added to this dessert (that were extracted in ethyl alcohol for testing the polyphenols, flavonoids and the antioxidant properties). The roses jam that we used was made with 2 types of roses: Rosa x Damascena and Rosa de Rescht and they were chosen for their calming, very rich vitamin C, polyphenols and flavonoids content, and for the nice aroma. Flavonoids help regulate cellular activity and fight off free radicals that cause oxidative stress on your body. In simpler terms, they help your body function more efficiently while protecting it against everyday toxins and stressors (Kathryn Watson 2019). Epidemiological studies and associated meta-analyses strongly suggest that long term consumption of diets rich in plant polyphenols offer protection against development of cancers, cardiovascular diseases, diabetes, osteoporosis and neurodegenerative diseases (Kanti Bhooshan Pandey and Syed Ibrahim Rizvi 2009). Hibiscus and beetroot have a nice color combination due to their pigments that when combined gives a nice bright pinkish red and for their fibers, iron, betacyanin (beetroot) and beta-carotene, anthocyanins and vitamin C (hibiscus). The green spirulina is a well known super food in this modern world and in this dessert is used for the nice color that pairs nicely with the red from the hibiscus and beetroot but it also brings a lot of nutrients and bioactive compounds such as phycocyanin that has brain-protective properties. The cream was also improved with coenzyme Q10, essential for 94% of all energy processes in the body, it helps prevent neurodegenerative and cardiac diseases. As economic and practical applicability, these plant based extracts and pigments have been used in the production of macarons, a delicious, colorful dessert, attractive even for children, rich in vitamins and minerals, in bioactive compounds, which help to reach the daily intake necessary for a healthy person.

Keywords: FT-IR, vitamins, bioactive

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INTRODUCTION

Macarons are a light, airy and sweet dessert which on his own has a lot of beneficial bioactive compounds such as magnesium and vitamin E due to the almonds that are used for making them. Almonds are one of the few sources of vegetable proteins which contain arginine. This is an amino acid essential for children. It has a notable amount of soluble fibre (10 g of fibers for 100 g of almonds), which benefits gastrointestinal transit. And also almonds can help lower your systolic blood pressure, which offers even more protection against heart diseases (Dr. Nikita Toshi 2023).

The cream that fills the macarons is made using cream cheese which has a lot of proteins, vitamin A (very important for the eyes, skin and hair especially to children), riboflavin

(riboflavin or vitamin B2 works to reduce oxidative stress and inflammation of nerves, which are contributors to migraine headaches. It is also needed for normal mitochondrial activities), and let's not forget that cream cheese is low in lactose and has probiotics that help support your immune system by reducing inflammatory response (Adda Bjarnadottir 2019).

Beetroot is one of the key ingredients I chose for these macarons for the bright red color but also because it contains betacyanin which has some anti-cancer properties, due to the high nitrate concentration it lowers the blood pressure, it also improves exercise performances and supports energy levels, it is really rich in fibre content that helps improve the digestive health and the presence of glutamine only enriches these effects and has

important antioxidant and anti-inflammatory properties (Jo Williams 2014).

Hibiscus is used for its color which is a magenta-red but also for its impressive antioxidant effects due to the beta-carotene, anthocyanins and vitamin C that is present in this flower. It lowers the blood pressure, the cholesterol, fights bacteria and inflammation but also promotes weight loss and supports liver health (Rachael Ajmera 2023).

Roses are used for the sweet aroma, and for their substantial concentration of vitamin C that rivals even the citruses. The benefits of consuming roses are: cooling the gastrointestinal tract, promoting restful and peaceful sleep, soothes nervous, angry and sad emotions, may reduce wrinkles and slow down skin aging, balances hormones (including amenorrhea), soothes sore throats and reduces inflammation (Mohammad Hossein Boskabady et al, 2011).

Green spirulina is the green natural pigment that I chose for dyeing my cream but I also took into consideration the bioactive compounds that is found in it. Phycocyanin is a powerful plant-based protein that is found in green spirulina and it may have antioxidant, pain-relief, anti-inflammatory and brain-protective properties. Also most of the many antioxidants that green spirulina has are having anti-inflammatory effects. The other effects that I took into consideration were the ability to improve cholesterol and triglyceride levels, reducing the blood pressure, suppressing the oxidation and lowering the blood sugar levels (Joe Leech, 2023).

Coenzyme Q₁₀ it is a component of the electron transport chain and participates in aerobic cellular respiration, which generates energy in the form of ATP. 95% of the human body's energy is generated this way. Organs with the highest energy requirements—such as the heart, liver, and kidney—have the highest CoQ₁₀ concentrations. That is why this coenzyme (that acts the way a vitamin does) is really important in our diet. If we do not reach the daily intake of CoQ₁₀ we can risk having heart diseases or neurological ones like Huntington disease (Arlene Semeco et al, 2023).

FT-IR spectroscopy is often used in the food industry for the analysis of products or ingredients used (Plesa et al, 2022).

Using the vibrational spectroscopy method I analysed the samples (powder) obtained from beetroot and green spirulina. FT-IR, offers several advantages in the context of current

research and using this techniques we can identify molecular components in the samples studied (Alexa et al., 2009). IR spectroscopy is based on the absorption of radiation in the 400 – 4000 cm⁻¹ range which excites molecular vibrations.

MATERIAL AND METHOD

The ingredients used for Macarons (C stand for vitamin C) were: sugar, almond flour, egg whites, cream cheese, butter, rose jam, beetroot extract, hibiscus extract and green spirulina powder.

Each of these macarons has 50 grams (after they got the humidity from the air when they got stored for at least 24 hours in the fridge), the ingredients being chosen carefully in order to have a good effect. Every macarons has 9g sugar, 3g almond flour, 3g egg whites, 5g cream cheese, 5g butter, 5g rose jam, 5g extracts and 1g vitamin C and 0.8g CoQ₁₀.

The cooking process is not easy and needs a higher level of experience in this domain. The egg whites are beaten in a bowl with vitamin C which helps stabilising them (cream of Tartar can be used as well or acetic acid but the second option might result in an unwanted consistency), the white sugar (crystal) is added slowly and the whites are beaten until stiff/firm peaks. The almond flour and the powdered sugar are mixed well and sifted for achieving a fine granulation. The mixture is added in 3 separate rounds and mixed with the egg whites. Now we do the macronage which means mixing them to release some of the air (fig. 1). The macronage is done when we can draw a figure 8 with the batter without breaking it. The batter is piped on a baking sheet in the desired shape (traditionally round) and the tray is hit by the counter until all the unwanted air bubbles that were left in them rise to the top. With a toothpick we break those bubbles so we don't have broken macarons and we let them for 30 minutes to 1 or 2 hours (depending on the temperature and the humidity of the room) to create a film that is firm to the touch (this step is important because it makes sure that the macarons only rise and do not expand so our macarons can have a „foot“). After the drying process is done and the film is present on every macarons we bake them for 30 minutes at 130 degrees Celsius (or until they start to get a little bit of a golden-brown on the top). We let them cool a little for 5-7 minutes and we take them off the baking sheet

to let them cool off and paying attention to the condensation. Any cream can be used for filling in between 2 macaron cookies but is important



Figure 1. The macronage technique.

FT-IR spectroscopy experimental

The samples of beetroot was dried at room temperature and after this was crushed using a commercial blender obtaining a powder that was used on the same day (green spirulina is already a powder so these steps were not necessary). The powders of green spirulina and beetroot are presented in figure 2.



Figure 2. Green spirulina and beetroot powders

The sample was prepared using calcinated potassium bromide as a matrix material and was mixed at a proportion of 3 mg of the to 200 mg KBr. Then the mixture was condensed in 15 mm dies at a pressure equal to 10 t till 2 min. Same procedure was applied for all samples (Crişan et al., 2019). In figure 3 is presented the hydraulic press that we used.

to let them sit in the fridge for at least 24 hours before serving or eating them (48 hours is the best time).

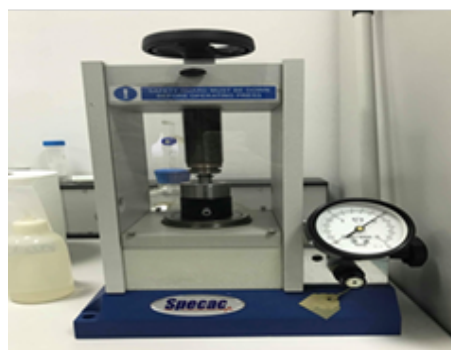


Figure 3. The Specac hydraulic press.

Measurements were carried out on the infrared scale of $350\text{-}4000\text{ cm}^{-1}$ and a spectral resolution was set at 4 cm^{-1} using a Jasco FT-IR-4100 spectrophotometer (Oklahoma City, OK United States) using KBr pellet technique (fig. 4). All spectra were acquired over 256 scans. The spectral data were analysed using Origin 6.0 software. Measurements were carried out on infrared scale of $500\text{-}4000\text{ cm}^{-1}$.

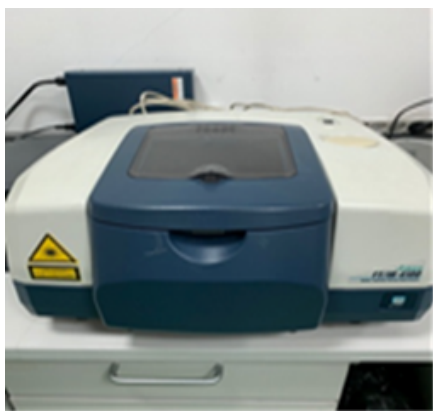


Figure 4. Jasco Spectrophotometer 4100

Natural beetroot powder were evaluated by FT-IR spectral data as shown in figure 5 and in figure 6 is the green spirulina. The spectrum obtained from beetroot (fig. 5) highlights the presence of the functional group of polysaccharides through the presence of the band at 1052 cm^{-1} . In the same spectrum, you can see the band at 1579 cm^{-1} which is due to the C=C group.

RESULTS AND DISCUSSION

FT-IR analysis

The FT-IR spectra were used to identify the functional groups of the macronutrients bades on the IR absorption in typical spectral regions.

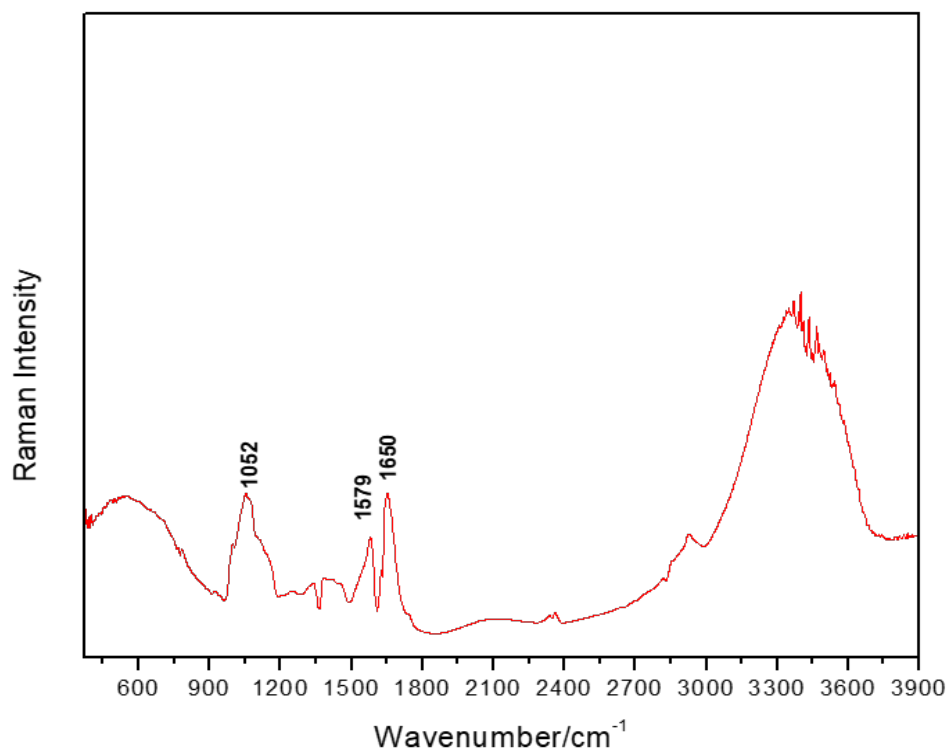


Figure 5. FT-IR spectrum of beetroot.

Analyzing the spectrum obtained for spirulina (fig. 6) one can observe a high intensity of the 1654 cm^{-1} band which is due to

the N-H vibrational group, indicating the presence of ketone amide.

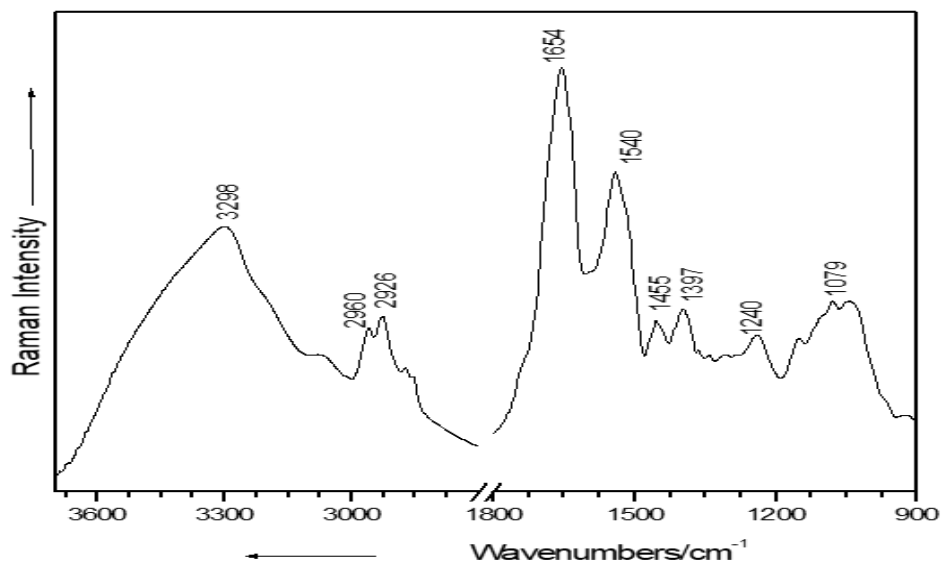


Figure 6. FT-IR spectrum of green spirulina.

In Table 1 we can see the polyphenol concentration determined using the **Folin-Ciocalteu** method, flavonoides concentration

using the AlCl_3 method and the antioxidant activity using the DPPH method.

Table 1.

The bioactive compounds found in ethanolic extracts

Name	Polyphenols GAE/g	Mg	Flavonoides Mg Qe/g	DPPH mMols Trolox/g
<i>Rosa x Damascena</i>	172,3 mg		293,3 mg	200 mMols
<i>Rosa de Rescht</i>	186,4 mg		202,2 mg	188,3 mMols
<i>Hibiscus syriacus</i>	14,97 mg		4,01 mg	9,17 mMols
<i>Beta vulgaris</i>	8,1 mg		7,90 mg	14,01 mMols
<i>Arthrospira platensis</i>	85,55 mg		2,27 mg	15,39 mMols

As we can see the highest quantity in polyphenols, flavonoides and antioxidant properties are given by the roses, especially *Rosa x Damascena* (172, 3 mg polyphenols, 293,3 mg flavonoids and 200 mMols Trolox) but *Rosa de Rescht* has a little bit more polyphenols (18,4 mg). The least polyphenols were present in beetroot and the least flavonoids in hibiscus. Surprisingly the least antioxidant effect was present when we tested the hibiscus. After these analysis we decided to use more rose jam rather than our hibiscus, beetroot and green spirulina extracts so we can give to our customers more bioactive compounds.



Figure 7. The MaCarons that we created.

Using the ingredients mentioned we obtained these macarons shown in figure . Table 2 presents the ingredients we used for our MaCarons (2 pieces/100 grams) and their nutritional information.

Table 2.
Nutritional information for 22 macarons (one portion using these quantities)

Food	Quantity	Serving size	Calories	Fat	Carb	Protein
Sugar	18,18	grams	72,72	0	18,18	0
Almond flour	5	grams	29,5	2,445	1,065	0,98
Egg whites	0,45	servings	7,11	0,01	0	1,81
Cream cheese	4,54	grams	15,90	1,56	0,25	0,28
Butter	4,54	grams	49,09	4,54	0	0
Beetroot, hibiscus and green spirulina extracts	0,45	grams	0,09	0	0,01	0,01
Rose jam	4,5	grams	6,76	0	1,5	0,19
		SUBTOTALS	181,17	8,55	21	3,27

Table 3. presents the nutritional values for 2 MaCarons or 100 grams, finished product (after 24 hours in the fridge).

Table 3.
Nutritional information for 100 grams of macarons

Serving size 100 g	Amount per serving
Total Fat	8,55 g
Sugar	18,18 g

<i>Dietary Fiber</i>	<i>1,7 g</i>
<i>Total Carbohydrates</i>	<i>21 g</i>
<i>Sodium</i>	<i>0,2 g</i>
<i>Proteins</i>	<i>3.27 g</i>
<i>Calories</i>	<i>182</i>
<i>Vitamin C</i>	<i>2 g</i>

Our MaCarons have little calories, just 83 calories for 1 macarons and you will get the necessary 1000 mg of vitamin C that you need for the day. They are low in sodium and low in fats. High in polyphenols (81 mg/100 grams) and flavonoids (112,5 mg/100 grams) that are very important for their antioxidant properties and their help with fighting against free radicals and cancerous cells. The low sodium content is important for the dietary restrictions so people that have a low sodium diet can enjoy this really delicious dessert. The high antioxidant effect of our super food is duet o the amount of polyphenols, flavonoids and vitamin C that is present in our MaCarons. The daily amount we recommend is 2 pieces or 100 grams to satisfy the daily needs of vitamin C.

CONCLUSIONS

In conclusion, after the following analyzes that we performed we can say that these products are ready to be used and have a high concentration of bioactive compounds.

The majority of peopple were pleased about the taste and the benefits that these MaCarons bring to the table. By consuming them we can bring a benefit to the body, have a healthier alternative to the sugary desserts and improving our health.

REFERENCES

1. Adda Bjarnadottir, 2019, Is Cream Cheese Healthy? Nutrition, Benefits, and Downsides. Found at: <https://www.healthline.com/nutrition/is-cream-cheese-healthy-nutrition-benefits-and-downsides> [last accessed 12.06.2023]
2. Arlene Semeco, Rachael Ajmera, 2023, 9 Benefits of Coenzyme Q10 (CoQ10). Found at: <https://www.healthline.com/nutrition/coenzyme-q10> [last accessed 12.06.2023]
3. Crişan I., Vidican R., Olar L., Stoian V., Morea A., Ştefan R., 2019, Screening for Changes on *Iris germanica* L. Rhizomes Following Inoculation with Arbuscular Mycorrhiza Using Fourier Transform Infrared Spectroscopy. *Agronomy* 9:815 doi:10.3390/agronomy912081
4. Jo Williams, 2014, Top 5 health benefits of beetroot. Found at: <https://www.bbcgoodfood.com/howto/guide/ingredient-focus-beetroot> [last accessed 12.06.2023]
5. Joe Leech, 2023, 10 Health Benefits of Spirulina. Found at: <https://www.healthline.com/nutrition/10-proven-benefits-of-spirulina> [last accessed 12.06.2023]
6. Kanti Bhooshan Pandey and Syed Ibrahim Rizvi, 2009, Plant polyphenols as dietary antioxidants in human health and disease, *Oxid Med Cell Longev.* 2(5): 270–278.
7. Kathryn Watson, 2019, What Are Flavonoids? Everything You Need to Know. Found at: <https://www.healthline.com/health/what-are-flavonoids-everything-you-need-to-know> [last accessed 12.06.2023]
8. Mohammad Hossein Boskabady, Mohammad Naser Shafei, Zahra Saberi and Somayeh Amini, 2011, Pharmacological Effects of *Rosa Damascena*. *Iran J Basic Med Sci.* 14(4): 295–307