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Research Article

Formulation and Antioxidant Activity Test of Purple Button Herb Ethanol Extract Peel-Off Mask

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Abstract

Purple button herb (*Borreria laevis* Lamk) contains secondary metabolites, including flavonoids, saponins, phenolics, tannins, and steroids, which have antioxidant activity. Facial masks include pharmaceutical preparations for cleaning, maintaining, and increasing attractiveness. This study aims to formulate a peel-off facial mask preparation from purple button herb extract (*Borreria laevis* Lamk), which is good and stable as an antioxidant. Ethanol extract from purple button herb was used as an active ingredient in the manufacture of peel-off gel masks with concentrations of 5% (F1), 10% (F2), and 15% (F3) with several physical evaluations including homogeneity, organoleptic (odor, color, shape), pH, drying time, viscosity and antioxidant activity tests carried out using the DPPH method. The results of the antioxidant activity test showed that the peel-off gel mask formula of ethanol extract of purple button herb at concentrations of 5%, 10%, and 15% met the requirements of a good and stable preparation with an IC_{50} value at a concentration of 5% (F1) of 149.82 µg/mL in the moderate category for antioxidant activity. Based on the test results, the purple button herb can be an antioxidant formulated for peel-off facial masks.

Keywords: Antioxidants, Peel-off face mask, Purple button herbs

Formulasi dan Uji Aktivitas Antioksidan Masker Wajah Peel-Off Ekstrak Herba Kancing Ungu

Abstrak

Herba kancing ungu (*Borreria laevis* Lamk) mengandung metabolit sekunder seperti flavonoid, saponin, fenolik, tanin dan steroid yang memiliki aktivitas sebagai antioksidan. Sediaan farmasi yang digunakan untuk membersikan, memelihara, dan menambah daya tarik salah satunya adalah masker wajah. Penelitian ini bertujuan untuk memformulasi sediaan masker wajah *peel-off* dari ekstrak herba kancing ungu (*Borreria laevis* Lamk) yang baik dan stabil sebagai antioksidan. Ekstrak etanol Herba kancing ungu digunakan sebagai bahan aktif pada pembuatan masker gel *peel-off* dengan konsentrasi sebesar 5% (F1), 10% (F2), dan 15% (F3) dengan beberapa evaluasi fisik yang meliputi homogenitas, organoleptik (bau, warna, bentuk), pH, waktu mengering, viskositas, serta uji aktivitas antioksidan yang dilakukan dengan menggunakan metode DPPH. Hasil formulasi menunjukkan bahwa formula masker gel *peel-off* ekstrak etanol herba kancing ungu kosentrasi 5%, 10% dan 15% memenuhi syarat sediaan yang baik dan stabil, dengan nilai IC_{50} dari uji aktivitas antioksidan pada kosentrasi 5% (F1) sebesar 149,82 µg/mL yang termasuk kategori sedang. Berdasarkan hasil tersebut, herba kancing ungu (*Borreria laevis* Lamk) dapat berpotensi dikembangkan sebagai agen antioksidan untuk formulasi masker wajah peel-off.

Kata Kunci: Antioksidan, Herba kancing ungu, Masker *peel-off*

1. Introduction

Skin is the body's protective layer from exposure to environmental pollution, especially facial skin, which is often exposed to ultraviolet (UV) rays, which can cause skin problems such as wrinkles, aging, acne, and enlarged skin pores, so it is essential to care for the skin itself.[1] Antioxidants protect the skin from damage caused by free radicals, which can accelerate skin aging and increase the risk of cell damage. These free radicals often form due to environmental exposure, including sun ultraviolet (UV) light. UV light, especially UVA and UVB, triggers the formation of reactive oxygen species (ROS) in skin cells. The ROS are highly reactive and unstable molecules that can damage cellular components such as DNA, lipids, and proteins. Topically applied antioxidants, such as vitamin C, E, and polyphenols, effectively protect the skin from free radical damage. In addition, these compounds can improve skin structure, increase collagen production, and reduce signs of aging. Antioxidant-based skin care products are now a significant concern in the cosmetic industry, given their broad benefits in supporting skin health and beauty.[2] Cosmetics are ingredients or mixtures used on the surface of human skin to clean, maintain, and increase attractiveness. Cosmetics are not included in the drug class. One example of cosmetics is a facial mask.[3]

The characteristics of a facial mask are that it can be applied to facial skin, creates a tight feeling on the skin, and contains elements of substances that are beneficial for the skin. Many types of masks are on the market, including powder, cream, gel, and paper or cloth. Peel-off face masks are designed to be applied in gel or paste form, which, after drying, can be slowly removed from the skin's surface. The difference with other masks, such as clay or sheet masks, lies in their use. Clay masks are usually applied and left to dry, then rinsed with water, while sheet masks are cloth masks placed on the face and removed after a while without rinsing. Peel-off face masks generally contain ingredients that allow the product to dry and form an elastic film layer that easily peels from the skin, providing a deep cleansing sensation and removing dirt or dead skin cells. Peel-off facial masks are a very popular beauty treatment to improve skin quality.[4]

As anti-aging skin, peel-off gel mask preparations are in great demand among women and men. Apart from that, peel-off gel masks are classified as skin care cosmetics products that can be used as a moisturizer and skin softener. The skin's primary function is to protect the inside of the body from external environmental influences such as physical, mechanical, chemical, bacterial, and sun exposure. As skin ages, it will experience aging, causing the skin to become dull and rough. To overcome this, anti-aging cosmetic products containing antioxidant compounds can be used for skin protection and care.[5]

Antioxidants can now be found in gels, lotions, serums, and tablets, among other dosage forms. Preparations for facial skin are prepared as topical cosmetic preparations rather than oral preparations; the antioxidant benefits are preferred. One of the many types of topical cosmetic dosage forms, one of which is in the form of a peel-off gel mask.[6]

Traditionally, the community uses button herb (*Borreria laevis* Lamk) as a medicine for intestinal inflammation (appendicitis). According to research by Yuliastri et al.,[7] the ethanol extract of the purple button herb (*Borreria laevis* Lamk) contains metabolite groups, including flavonoids, saponins, phenolics, tannins, and steroids. Flavonoids can capture and neutralize free radicals, such as superoxide (O_2•) and hydroxyl radicals (OH•), which are harmful to cells. This ability comes from its chemical structure containing a phenolic ring with a hydroxyl group (-OH), which readily donates electrons to neutralize free radicals. Saponins can bind heavy metals that can stimulate the formation of ROS, reducing the formation of lipid peroxides that are harmful to cell membranes and other biological components. Phenolates work by donating electrons from their hydroxyl groups to neutralize free radicals, thereby reducing the damage these free radicals can cause. Tannins work by binding and neutralizing free radicals that are harmful to cells. The hydroxyl group

in the tannin structure is very effective in binding free radicals and protecting cells from oxidative damage. Steroids can increase the stability of cell membranes by interacting with lipids in the membrane, thereby preventing damage due to oxidation and strengthening the membrane's defense against oxidative stress. The ethanol extract of the herb purple button grass (*Borreria Laevis* Lamk) using the DPPH method had an IC_{50} value of 20.722 ppm (very strong activity). In contrast, the DPPH and FRAP test methods obtained IC_{50} values of 23.565 ppm and 29.186 ppm (very strong activity).[7]

Antioxidants and peel-off masks work together to enhance skin protection and care. Peel-off masks help cleanse and prepare the skin, while antioxidants protect against oxidative damage and improve skin condition. By combining these two elements, peel-off masks can effectively fight the signs of premature aging, protect the skin from free radicals, and improve overall skin health.[8] Based on the explanation above, we are interested in formulating purple button herb extract into a peel-off mask and activating its antioxidant activity.

2. Methods

2.1. Tools

Equipment used for extraction included maceration containers, glassware (Pyrex®), analytical balances (Ohaus®), rotary evaporators (BUCHI® R-100), flasks (Pyrex®), and water baths (Memmert®). Equipment used for formulation includes stirring rods (Pyrex®), mortars and stampers (Duran®), dropper pipettes (Pyrex®), watch glasses (Duran®), porcelain cups (Duran®), beakers (Pyrex®), spatulas (Kimble®), label paper (Kimble®), vials (Kimble®), ovens (Memmert®), hot plates (IKA®), Universal pH (Hanna®), VT-Rion viscometer. As for the antioxidant assay, we used a UV-Vis spectrophotometer (Agilent Technology®) to determine the absorbance of the sample following the DPPH test.

2.2. Materials

The materials used in this research included purple button herb extract (*Borreria laevis* lamk), polyvinyl alcohol (Sigma-Aldrich®, USA), carbomer (Lubrizol®, USA), DPPH (Sigma-Aldrich®, USA), propylene glycol (Dow Chemical®, USA), benzoic acid (Sigma-Aldrich®, USA), glycerin (Sigma-Aldrich®, USA), oleum rosae (Pranarôm International, Belgia), 96% ethanol (Merck®, Germany) and distilled water (OneLab Water, USA).

2.3. Procedures

2.3.1. Sample preparation

Purple button herb (*Borreria laevis* Lamk) was obtained from Kendari City, Southeast Sulawesi, Indonesia. Sampling was carried out in the morning or during photosynthesis.

2.3.2. Sample Determination

Sample determination was conducted at the Pharmacognosy-Phytochemistry, Faculty of Science and Technology, Mandala Waluya University (AREC Reg. No: 042/09.3.01/VII/2023).

2.3.3. Sample Processing

Sample processing began with collecting raw materials and harvesting purple button herbs. The collected purple button herb was washed thoroughly with running water, drained, and wet sorted to separate dirt or foreign objects. Then, it was cut into small pieces and dried by airing it without direct sunlight. Finally, the dried purple button grass herb was blended until it became powder and sifted.

2.3.4. Sample Extraction

The extract was prepared through maceration using dried and powdered purple button herb leaves (simplicia). Five hundred grams of the herb powder was soaked in 3 liters of 96% ethanol as the solvent. The cold extraction process involved macerating the herb powder for three cycles of 24 hours each in a tightly sealed container. During this time, the mixture was occasionally stirred and stored in a location shielded from sunlight. After the 72-hour maceration, the mixture

was filtered using flannel cloth and a filter funnel. The filtrate was then evaporated using a rotary vacuum to produce a brownish-black ethanol extract.

2.3.5. Peel-off Face Mask Formulation

The peel-off face mask formulation involves several steps to ensure the product's quality, stability, and effectiveness. The peel-off gel mask was made by dissolving PVA with warm distilled water (80°C) until it expanded for approximately 15-30 minutes; after expanding, it was ground until homogeneous (mass 1). In a mortar, PVA is developed using hot water that has been prepared previously for 15 minutes. Then, it was ground until the mass became homogeneous (mass 2). Benzoic acid and propylene glycol are combined in hot distilled water until dissolved, then added and mixed until homogeneous into mass 1. Then, mass 1 and 2 are mixed into a mortar and stirred until homogeneous (mass 3). The remaining distilled water is gradually added to mass 3 by grinding until the gel mass becomes homogeneous. Purple button herb extract is dissolved with a bit of 70% ethanol and then filtered using filter paper to be added to the base gradually and ground until homogeneous. The finished mask is put into a suitable container and labeled according to the mask concentration. Then, an evaluation of the preparation is carried out.[9]

2.3.6. Physical Evaluation of Peel-Off Mask Preparation Purple Button Herb Extract

– Organoleptic Observations

Organoleptic tests were carried out by directly observing changes in the gel mask preparation, such as color, odor, and shape changes.[10]

– Viscosity and Rheology Testing

A total of 100 ml of gel was placed in a 250 ml beaker, and its viscosity was measured using a Rion Viscometer. The spindle type and rotation speed were adjusted as needed. Viscosity testing was conducted over three weeks—during the first, second, and third weeks. The Rion Viscometer was prepared to measure viscosity, and the rotor was installed. The rotor was positioned at the center of the gel container and activated, causing it to rotate. The viscosity indicator needle moved to the right, and the reading was recorded once the needle stabilized on the viscometer scale. The acceptable viscosity range for semi-solid preparations is 50–1,000 dPas.[11]

Rheology testing followed the rotational viscometry method. The appropriate spindle type was selected based on the gel's viscosity: larger spindles for more viscous samples and smaller spindles for thinner ones. After securely installing the spindle, it was fully submerged in the gel without touching the bottom of the container, and the device was switched on. The rotation speed was adjusted, and the viscosity reading was taken after a few seconds or minutes, typically in centipoise (cP) or Pascal-seconds (Pa·s). For non-Newtonian samples, measurements were taken at multiple rotation speeds to analyze viscosity changes relative to shear rate.[12]

– pH testing

pH testing was essential to ensure that the facial mask formulation aligns with

Table 1. Peel-off Face Mask Formulation from purple button herb extract (*Borreria laevis* Lamk.)

Materials	Concentration (%)			Function
	F1	F2	F3	
Extract	5	10	15	Active substance
PVA	13	13	13	Gelling agent
Carbomer	2	2	2	Viscosity enhancer
Propilen glycol (plastisizer)	10	10	10	Humectan
Benzoic acid	0.1	0.1	0.1	Preservative
Glicerin (plastisizer)	5	5	5	Humectan
Oleum Rosae	q.s	q.s	q.s	Fragrance
Aquadest	ad 100	ad 100	ad 100	Solvent

the skin's pH (4.5–6.5), making it safe and comfortable for use. The pH meter was turned on and calibrated using standard buffer solutions (pH 4, 7, and 10). The electrode was submerged completely, ensuring it did not touch the bottom or walls of the container. The reading was allowed to stabilize for a few seconds. The pH value displayed on the pH meter was then recorded.

– Homogeneity Testing

Homogeneity testing was carried out by smearing 1g of gel on a piece of glass and then covering it with another piece of glass, observing whether there were any coarse grains that were not homogeneous.[13]

– Stability

The stability of the mask preparation can be determined by carrying out a cycling test for 6 cycles. The mask was stored at 5°C±2°C for 24 hours and then transferred to an oven at 40°C for another 24 hours. The time during storage at these two temperatures was considered one cycle. The mask preparation was then observed for changes in color, aroma, gel form, pH, spreadability, and drying time. Antioxidant activity tests were carried out before and after the cycling test.[14]

– Drying Time Test

This test was conducted by observing how long the preparation dries after being applied to the back of the hand. The preparation was said to be dry if it formed a dry film layer, whereas the preparation was good if it dried within 15-30 minutes.[15]

– Spreadability Test

To test the spreadability, 1 g of the peel-off mask preparation was weighed, placed on a glass, covered with another glass, and given a weight of 150 g. After 1 minute, the diameter formed was measured.[16]

2.3.7. Antioxidant Activity Test

The test solution was prepared by taking 1 mL of each concentration of the DPPH solution with a concentration of 100 mg/L. Two milliliters of methanol were added, and the mixture was placed into a test tube and incubated for 30 minutes at 37°C. The absorbance was then measured at a wavelength of 517 nm. The dark purple DPPH radical was reduced to a yellow non-radical form if the antioxidant activity was present in each tested concentration.[17] The determination of the half inhibitory concentration (IC_{50}) of antioxidant activity was carried out from the results of measuring the absorbance of three concentrations to produce % inhibition, which was calculated based on the equation:

$$\%\ \text{inhibition} = \frac{\text{blank absorbance} - \text{sample absorbance}}{\text{blank absorbance}} \times 100\%$$

The percentage of inhibition and the concentration of the extract were plotted on the x and y axes, respectively, and the equation of the obtained line was used to calculate the IC_{50} value. The data to be inputted were the results of antioxidant activity data. The calculation of the IC_{50} value was generally carried out using the Non-Linear Regression using the SPSS version 28 (IBM, USA).

3. Result

The peel-of-face mask formulation test showed promising results starting at the extraction stage, after which the formulation was made, and antioxidant testing was carried out. Evaporation was carried out to concentrate the extract and separate the 96% ethanol solvent from the active substance content in the purple button herb. The yield value of 19.6% was quite suitable for ethanol extraction (Table 2), indicating the efficiency of the solvent in extracting bioactive compounds.

3.1. Organoleptic, Viscosity, pH, Homogeneity, Drying Time, and Spreadable Test of Peel-Off Facial

Table 2. Results of ethanol extract of purple button herb (*Borreria laevis* Lamk)

Solvent	Powder (g)	Extract (g)	Yield (%)
96% Ethanol	500	98	19.6

Mask Preparations

Table 3 revealed the organoleptic test of the button herb extract (*Borreria laevis* Lamk) peel-off facial mask preparation based on its shape, odor, and color. Viscosity testing aims to determine the viscosity value of a substance. The higher the viscosity value, the higher the viscosity level of the substance.[19] The viscosity test results on the peel-off face mask formulation showed consistent values and were within the acceptable range for this cosmetic product. The viscosity measurements produced values of 106.6 dPas and 100 dPas alternately, with good stability in repeated measurements. These results were within the recommended viscosity range of 50-1000 dPas, which was suitable for ensuring ease of application to the skin and the ability to form a homogeneous and easy-to-peel layer after drying. Slight variations between measurements (106.6 dPas and 100 dPas) can be attributed to the homogeneity of the formulation during testing and are still considered within reasonable tolerance limits.[20]

The dry time test determined how long the old peel-off mask takes to dry on the skin surface and form a film layer. First sample (25 seconds): very fast drying, within the parameter limits. The second sample (4 seconds): very fast but outside the parameter limits (below 150 seconds), which may indicate a formulation problem, such as too-fast evaporation. Third sample (40 seconds): Still below the minimum limit (150 seconds) but closer than the second sample. All samples are within the parameter limits (150 seconds to 30 minutes). However, the 4 minutes was relatively short compared to the others, which may indicate formulation variation. The constant spread value (17 cm) indicates that the product has good physical stability and no significant change in spread properties during storage.

The spreadability test aimed to determine the softness of the gel mass so that it was easier to apply to the skin. Good dispersion caused extensive contact between the drug and the skin, so absorption of the drug into the skin occurs quickly.[21] The results of the spreadability test for three weeks showed that all the tested formulas (with three replications) each produced good spreadability and followed existing literature,[22] which can be seen in Table 3. The requirement for good spreadability for topical preparations is 5-7 cm. The spreadability test results demonstrated that the higher the purple button herb extract concentration in the peel-off mask, the smaller the spreadability. However, all peel-off mask preparations met the requirements.[18]

3.2. Antioxidant Activity Test of Peel-Off Facial Mask Preparations

The antioxidant activity test of the peel-off facial mask with the ethanol extract of purple button herb (*Borreria laevis* Lamk.) aims to determine whether a peel-off facial mask preparation was adequate as an antioxidant. Purple button herb extract (*Borreria laevis* Lamk), With an IC_{50} value of 149.8 ppm (Table 4), has moderate antioxidant activity, which still shows potential as a source of natural antioxidants. This value indicates that the extract has good antioxidant potential but needs further development for commercial use.

4. Discussion

The observations of the peel-off mask preparation of ethanol extract of purple button herb (*Borreria laevis* Lamk.) showed that the odor and color of the mask preparation were unchanged during 3 weeks of storage at room temperature. Formula 1 and 2 showed a thick texture, while Formula 3 displayed a very dense texture. This occurs due to the influence of the concentration of purple button extract used. The higher the concentration of purple button extract used, the thicker the resulting preparation. However, the preparation was still within the range of requirements for a good gel (semi-solid) preparation.[23] This showed stable purple button herb ethanol extract peel-off mask preparation.

The results of the viscosity measurements showed that the peel-off mask containing purple button herb extract (*Borreria laevis* Lamk.) experienced a decrease in viscosity

Table 4. Summary of Physical Property Tests of Peel-Off Face Mask Formulations at Various Temperatures Before Storage

Category	Temperature (°C)	F1		F2		F3		Parameter[18]
		Before storage	After storage	Before storage	After storage	Before storage	After storage	
Organoleptic Test	25	Light green, rose oil, semi solid*	Light green, rose oil, semi solid*	Brownish green, rose oil, semi solid*	Brownish green, rose oil, semi solid*	Deep green, rose oil, semi solid*	Deep green, rose oil, semi solid*	Green to dark green in color, the aroma of rose oil has a semi-solid and soft consistency.
	4	Light green, rose oil, semi solid*	Light green, rose oil, semi solid*	Brownish green, rose oil, semi solid*	Brownish green, rose oil, semi solid*	Deep green, rose oil, semi solid*	Deep green, rose oil, semi solid*	
	40	Light green, rose oil, semi solid*	Light green, rose oil, semi solid*	Brownish green, rose oil, semi solid*	Brownish green, rose oil, semi solid*	Deep green, rose oil, semi solid*	Deep green, rose oil, semi solid*	
Viscosity Test	25	106.6* dpas	100 *dpas	106,6* dpas	100 *dpas	106,6* dpas	100 *dpas	50 - 1000dpas
	4	106.6* dpas	100 *dpas	106,6* dpas	100 *dpas	106,6* dpas	100 *dpas	
	40	106.6* dpas	100 *dpas	106,6* dpas	100 *dpas	106,6* dpas	100 *dpas	
pH Test	25	5*	5*	6*	6*	5*	5*	4,5 - 6,5
	4	5*	5*	6*	6*	5*	5*	
	40	4*	4*	6*	6*	5*	5*	
Homogeneity Test	25	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous, there were no coarse particles
	4	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	
	40	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	Homogeneous*	
Drying Time Test	25	17 cm*	17 cm*	17 cm*	17 cm*	17 cm*	17 cm*	150 second – 30 minutes
	4	17 cm*	17 cm*	17 cm*	17 cm*	17 cm*	17 cm*	
	40	17 cm*	17 cm*	17 cm*	17 cm*	17 cm*	17 cm*	
Spreadability test	25	7* cm	7* cm	8.2 cm	8.2 cm	8.2 cm	8.2 cm	5.7 cm
	4	7.2 cm	7.2 cm	8.2 cm	8.2 cm	8.2 cm	8.2 cm	
	40	7.2 cm	7.2 cm	8.2 cm	8.2 cm	8.2 cm	8.2 cm	

during storage for three weeks. This could be caused by prolonged storage, so old preparations are affected by the environment, such as air. Peel-off mask preparations contain glycerin, which is hygroscopic and has high activity to attract and hold water molecules and maintain stability by absorbing moisture from the environment and reducing water evaporation from the preparation.[24]

The peel-off mask from the preparation was found to have a pH range of 4.5–6.5. The pH of peel-off facial masks or cosmetic preparations should match or closely approximate the skin's physiological pH (4.5–6.5). Additionally, the purple button herb extract peel-off gel mask had a pH within the safe range for topical preparations, approximately pH 5–6.

The results of the antioxidant activity test showed that formulation 1 had the best IC_{50} value of 14.8 ppm, after the positive control with an antioxidant value of 9.31 ppm. Based on these results, the antioxidant activity of this formula is categorized as weak. This was due to several factors, including inappropriate storage conditions or unstable formulations that can cause degradation or loss of antioxidant activity from the preparation. Studies indicated that factors such as interaction with other ingredients in the formulation when extracts are mixed with additional ingredients in formulations such as emulsifiers, preservatives, or other substances, as the chemical interactions can alter the structure or activity of these antioxidant compounds.[25] The oxidation during the formulation process, such as during the manufacturing process of cosmetic or pharmaceutical formulations, can trigger the oxidation of active compounds, including antioxidants. This can lead to damage or a decrease in the ability of compounds to capture free radicals.[26] In addition, storage temperature and humidity can affect the stability of antioxidants in cosmetic products. The chemical form and solubility of antioxidant compounds in the formulation base could also affect their activity. Some antioxidant compounds are more effective in specific formulations than others, depending on their individual characteristics and chemical properties.[27]

5. Conclusion

The preparation of a peel-off gel mask of ethanol extract of purple button herb (*Borreria laevis* Lamk.) with concentrations of 5%, 10%, and 15% meets the requirements of a good and stable preparation based on organoleptic, viscosity, pH, drying time, and spreadability tests. The preparation of a peel-off gel mask of purple button herb has the best antioxidant activity in formula A with an IC_{50} value of 149.8 ppm in the medium category. Therefore, the formulation of a peel-off gel mask of ethanol extract of purple button herb (*Borreria laevis* Lamk.) has sufficient antioxidant potential to support skin protection from free radicals.

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Table 4. Results of the antioxidant test for the peel-off face mask of ethanol extract of purple button herb

sample	IC_{50} (ppm)
Vit. C	9.31
F1	149.8
F2	195.7
F3	182.8

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