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USE OF WASTE TEA LEAVES IN FACIAL CARE MASKS

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Abstract: The aim of the research was an attempt to obtain cosmetic care masks containing powdered waste leaves from red and green tea. On the basis of literature reports and our own research, original cosmetic formulas containing the addition of teas and the technology for their manufacture had been developed. Before incorporating the tea raw material into the cosmetic, it was dried to an adequate level of dryness and ground to a powder. The reference point in the evaluation was the base mask (without the addition of teas). Next, the functional properties of the cosmetic prototypes were evaluated. Viscosity, yield point, and skin moisturization were evaluated, and a sensory analysis of the developed masks was carried out. Based on the study, it was found that the masks containing the addition of powdered tea leaves had more favourable rheological and sensory properties, and showed a higher degree of moisturization two hours after washing the product off the skin, relative to the base mask.

Keywords: tea, facial care masks, face care, waste raw materials.

1. INTRODUCTION

The "Zero waste" trend has become more popular in recent times, based on the idea of combating the growing amount of waste and climate problems. The public is increasingly turning to eco-friendly products that have a positive impact on the environment. Consumer awareness of the possibility of managing waste materials has also increased [Anchisi, Meloni and Maccioni 2006; Moghtader 2013].

Tea is a widely consumed beverage around the world. However, as the popularity of tea consumption grows, so does the number of waste tea grounds, which, despite being brewed, contain enough active substances that, after proper preparation of the raw material, can be used in a cosmetic. Due to the presence of a number of active compounds – mainly polyphenols, which show anti-inflammatory, antibacterial, anticancerogenic, antiviral and, above all, antioxidant activities [Bujak et al. 2021].

Polyphenols are secondary metabolites that include flavonoids, such as flavanols, flavanones, anthocyanidins, isoflavonoids, flavanols, flavonic acids and tannins. The largest part of the polyphenols found in tea are flavanols, commonly known as catechins. We can distinguish among them: epicatechine, epigallocatechine, epigallocatechine, epigallocatechin gallate, etc. Green tea leaves are most often used in cosmetology, due to the fact that they can be distinguished by their high content of catechins (30–42% of the dry weight of the leaves). In red teas, on the other hand, the content of catechins ranges from 8 to 20% of the dry weight of the leaves. However, in addition to catechins, red tea also contains theaflavins and thearubigins, which also exhibit an antioxidant activity. These compounds are produced from catechins through oxidation and dimerization during the fermentation process, which does not occur in green tea [Bazinet, Labbe and Tremblay 2017].

Literature reports [Dmowski, Śmiechowska and Karwowska 2011; Grys et al. 2011; Michorczyk, Vogt and Ogonowski 2015; Bazinet 2017] indicate a correlation between tea steeping time and the content of active compounds in the aqueous decoction. Dmowski et al. [2011] conducted a study on the effect of brewing time on the content of selected biocomponents in "pu-erh" (red tea). They found that the prolonged effect of brewing red tea increased the content of polyphenolic compounds. Labbe, Tremblay and Bazinet [2006] conducted a study on the content of catechins in tea after the second brewing. Epigallocatechin and epicatechin content decreased after the second brewing, while epicatechin gallate and epigallocatechin gallate content increased.

In contrast, Bazinet et al. [2017] conducted a study to determine the beneficial brewing time and temperature of green tea. They showed that brewing tea in water at 50°C for 20–40 minutes is the most beneficial, due to the efficient extraction of epigallocatechin and epicatechins.

Face care masks are a special variety of skin care cosmetics, designed for the one-time cosmetic treatment of the skin. They are usually produced in the form of pastes, emulsions, suspensions, foams and gels. In recent years, new forms of such products are being developed, an example being the hydrogel patches that adjust to the shape of the face during application.

Masks are also available in the form of tablets or powder; however, the preparations, immediately before application, must be mixed with water or another type of activator. Masks contain in their composition various types of substances, designed to effectively improve the condition of the skin.

The main groups of raw materials used for this purpose are hydrophilic moisturizers (e.g. glycerine, urea), hydrophobic substances (oils and fats, waxes, silicones) and various types of active substances. Often the composition of masks is enriched with hydrophilic moisturizers and various types of emollients [Khomova, Gusakova and Nigmatullaev 1997; Klimaszewska et al. 2016a,b; 2018; 2021; Kulawik-Pióro et al. 2000; Zięba 2023].

In the literature [Draelos 2005; Meyer 2005; Zague et al. 2007; Sułek, Małysa and Totoń 2012; Ribeiro, Estanqueiro and Lobo 2015; Klimaszewska et al. 2021; Zięba 2023], the results of studies of cosmetic masks containing in their composition raw materials of natural origin are presented quite widely. Mainly used are sage extract, currant extract, aloe vera extract, natural peat extract, humic acid hydrolysate, ground walnut shells, crushed corn cobs, xanthan gum, tri-methylglycine, glycerine, and sorbitol. These products are usually solutions or dispersions whose viscosity has been increased by using a suitable polymer. Often the composition of masks is enriched with hydrophilic moisturizers and various emollients. Masks of this type are produced most often in the form of a hydrogel or emulsion. For such systems, various types of "green" solvents, surfactants or viscosity modifiers, certified as COSMOS or Eco-Cert type, are used as stabilisers.

Facial care masks containing tea extract are present on the market, but the addition of tea in the form of powder obtained from tea leaves has not been encountered.

The aim of this study was to use waste red and green tea leaves, after brewing, dried and powdered as full-fledged raw materials in facial care masks.

2. MATERIALS AND METHODS

2.1. Recipes and technology for facial care mask production

Based on the literature reports [Khomova, Gusakova and Nigmatullaev 1997; Kulawik-Pióro et al. 2000; Samber, Varma and Manzoor 2014; Zięba, Małysa and Wykrota 2015; Klimaszewska et al. 2016a,b; 2018; 2021; Małysa and Zatorska 2022; Zięba 2023] and our own research, different formulations of cosmetic masks were developed in the form of emulsions containing 1%, 2%, 3% or 4% by weight of powdered red and green tea leaves, and as a reference, a base mask with no tea added. Raw materials were used for the application of the mask, with names according to the INCI nomenclature: Ethylhexyl Hydroxystearate 100% (Croda), Vitis Vinigera Seed Oil – 100% (PHH Standard Polska), Cetyl Alcohol – 100% mixture of cetyl and stearyl alcohol (1:1) (BASF Niemcy), Ceteareth – 20 – 100% (PCC Rokita S.A.), Cera Alba – 100% (Alteya Organics), Glycerine – 100% (Pure Chemical), Sodium Benzoate, Potassium Sorbate (1:1) 50% water solution (Pol-Nil) Camelia Sinensis Green Tea (Yunnan Tea Poland), Camelia Sinensis Pu-erth Tea (Yunnan Tea Poland).

The formulations are shown in Table 1.

Table 1. Recipes of original face care masks

	Ingredients (INCI)	% by weight
OIL PHASE	Ethylhexyl Hydroxystearate	2
	Vitis Vinigera Seed Oil	8
	Cetyl Alcohol	6
	Ceteareth - 20	12
	Cera Alba	6
WATER PHASE	Aqua	up to 100
	Glycerin	4
	Sodium Benzoate, Potassium Sorbate	1
TEA LEAVES	Camelia Sinensis Green Tea	1,2,3,4
	Camelia Sinensis Pu-erth Tea	1,2,3,4

Source: own study.

2.2. Preparation of tea leaves in powder form

Yunnan red and green tea (Pu-erth) was used for the study. The procedure for preparing the raw material began with weighing 6 g of tea and then brewing in water at 80^{o}C for about 3 minutes. After 3 minutes, the leaves were separated from the infusion and excess water was squeezed out. Subsequently, the tea leaves were dried in a hothouse set at 70°C and dried to a suitable dryness on a weighing machine. The dried tea leaves were ground in a mill into powder in a Vevor brand electric mill. Particle size was not measured; however, according to the manufacturer, 30 seconds of grinding ensures that food materials are ground to a fine dust.

2.3. Technology for obtaining masks containing powdered teas

Face care masks were made according to the following procedure: the oil phase raw materials were added according to the order (Tab. 1) to a beaker placed in a water bath and stirred until dissolved. To a separate beaker placed in a water bath, the oil-phase raw materials were added and stirred until the components were combined. After both mixtures were brought to about 60°C, the contents of the beaker with the aqueous phase were added to the beaker with the oil phase while stirring continuously. The resulting emulsion was removed from the water bath and stirred until it cooled to about 25°C. Preservative and powdered tea leaves were added.

Figure 1 shows the appearance of the base mask (a) and the mask with the addition of powdered green tea (b).

a) b)

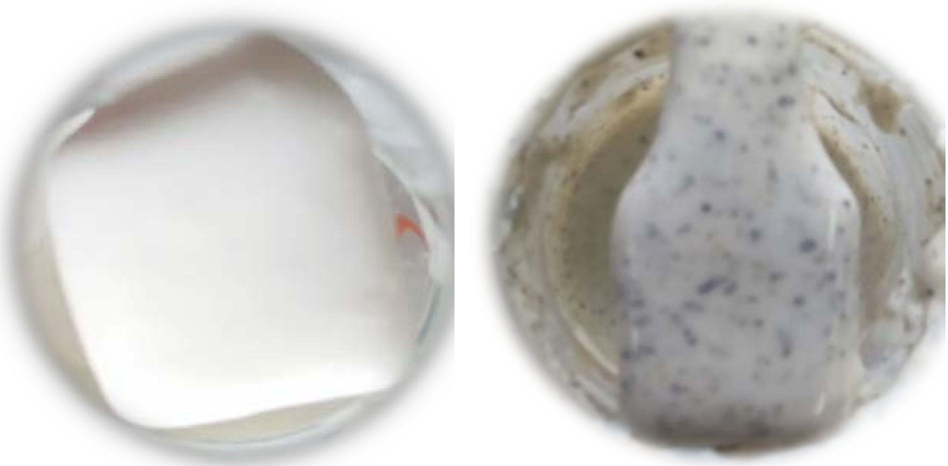

Fig. 1. Base mask (a) and the mask with the addition of powdered green tea (b)

Source: own study.

2.4. Stability

This test allows the determination whether a preparation is destabilized, e.g. separation into layers under the influence of changing temperature. For this purpose, a centrifuge test and a thermal test are used. The thermal test determines the behaviour of samples under the influence of temperature changes. The sample is held in a hothouse (phot) at 40ºC, and then in a refrigerator at 4ºC. This cycle was repeated alternately for 24 hours over a period of 7 days [Sułek, Małysa and Totoń 2012; Klimaszewska et al. 2016a,b].

2.5. Viscosity

Dynamic viscosity coefficient measurements were carried out using a Brookfield viscosity meter, type HA DV III Ultra. Measurements were performed at 21°C at a spindle speed of 5 rpm using Helipath type spindles. Three measurements were taken for each sample [Klimaszewska et al. 2018].

2.6. Yield Point

The values of the yield point of the tested cosmetic masks were determined using a Brookfield HA DV III Ultra viscosity meter equipped with a set of vane spindles. Measurements were carried out at constant spindle speeds of 5 rpm. The flow limit was the minimum value of shear stress above which body flow occurred. EZ-Yield Software was used to record the measurements and analyse them. Three measurements were taken for each sample [Klimaszewska et al. 2018].

2.7. Skin moisturization

The degree of skin moisturizing was measured using a Corneometer CM 825 probe coupled with a computer. The principle of measurement was based on the application of a measuring probe to the skin, the measurement occurred as a result of light pressing the measuring head to the skin on the inside of the forearm. Six measurements were taken on each test area at a time interval of 10 minutes. From the given values, the arithmetic mean was calculated for each sample [Sułek, Małysa and Totoń 2012; Zięba 2023].

2.8. Sensory assessment

The main purpose of the sensory tests was to evaluate product acceptability by consumers and to compare various product properties. A total of six properties were evaluated, including adhesion, consistency, homogeneity, cushion effect, spreading, absorption, stickiness, greasy sensation, abrasiveness and smoothing effects.

The evaluation was conducted in a group of 10 testers, and the final result was expressed as the arithmetic mean of the individual results. The sensory test was performed using a scaling method. The evaluation scale ranged from 1 to 5, with the following scores: 5 – very good, 4 – good, 3 – satisfactory, 2 – unsatisfactory, 1 – poor. The definitions and measurement procedures are described in the literature. Three measurements were taken for each sample [Sułek, Małysa and Totoń 2012; Klimaszewska et al. 2021].

3. RESULTS

3.1. Stability

The stability and appearance of the tested formulations is a very important aspect for further research and a criterion for the consumer to choose the product. Tests carried out on the preparations made according to the prepared formulation showed that they were stable and did not deseparate. It can therefore be concluded that the addition of red and green tea does not adversely affect their stability during storage at varying temperatures. A centrifuge test also gave positive results as the formulations did not separate.

3.2. Viscosity

The appropriate value of dynamic viscosity indicates a high content of active ingredients in the product and has an impact on its quality and properties. The correct viscosity of the product facilitates its application and spreading on the skin. The viscosities of the face care masks were measured on a Brookfield viscometer at 5 rpm.

The results obtained are presented in Figure 2.

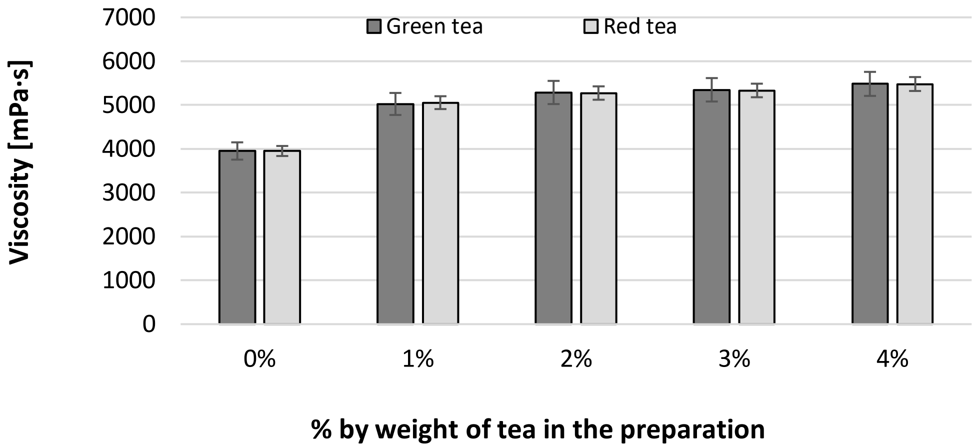

Fig. 2. Viscosity of original face care masks with red and green tea, T = 22ºC (n = 3, +/- SD)

For the base mask, without the addition of teas, a viscosity of about 3950 mPa-s was recorded. The addition of both red and green tea in concentrations of 1–4% as causes a slight increase in viscosity to a maximum of 5482 mPa-s. It can be noted that the addition of teas does not significantly affect the viscosity of the obtained facial care masks.

3.3. Yield point

The final appearance of a product is influenced by many issues, one of which is the study of the limit of flow of a given face care mask, which verifies the type of packaging or the way in which the masks will be applied to the skin or used by consumers.

The measurement results are shown in Figure 3.

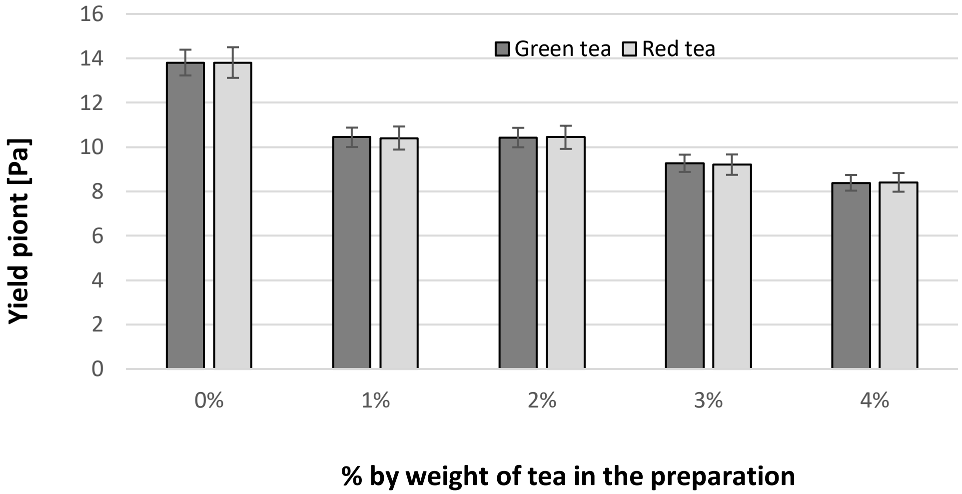

Fig. 3. Yield point of original face care masks with red and green tea, T = 22ºC (n = 3, +/- SD)

The addition of teas has a slight effect on lowering the yield point relative to the base mask, from a value of 18 Pa to a value of 10.4 Pa for concentrations of 1 wt.% and 2 wt.% tea, and to values of 9.20–8.40 Pa for concentrations of 3 wt.% and 4 wt.%. However, there were no major differences between the different tea concentrations. Lowering the threshold of the yield point with respect to the base results in the tested formulations having better applicability, i.e., better spreading and distribution on the skin.

3.4. Skin moisturization

The test was performed to assess moisture in the skin, measuring the water content of the stratum corneum. The effect is based on electrical conductivity, as the more water the skin's stratum corneum contains, the better the current flows, which means a higher level of skin moisturizing.

The measurement results are shown in Figure 4.

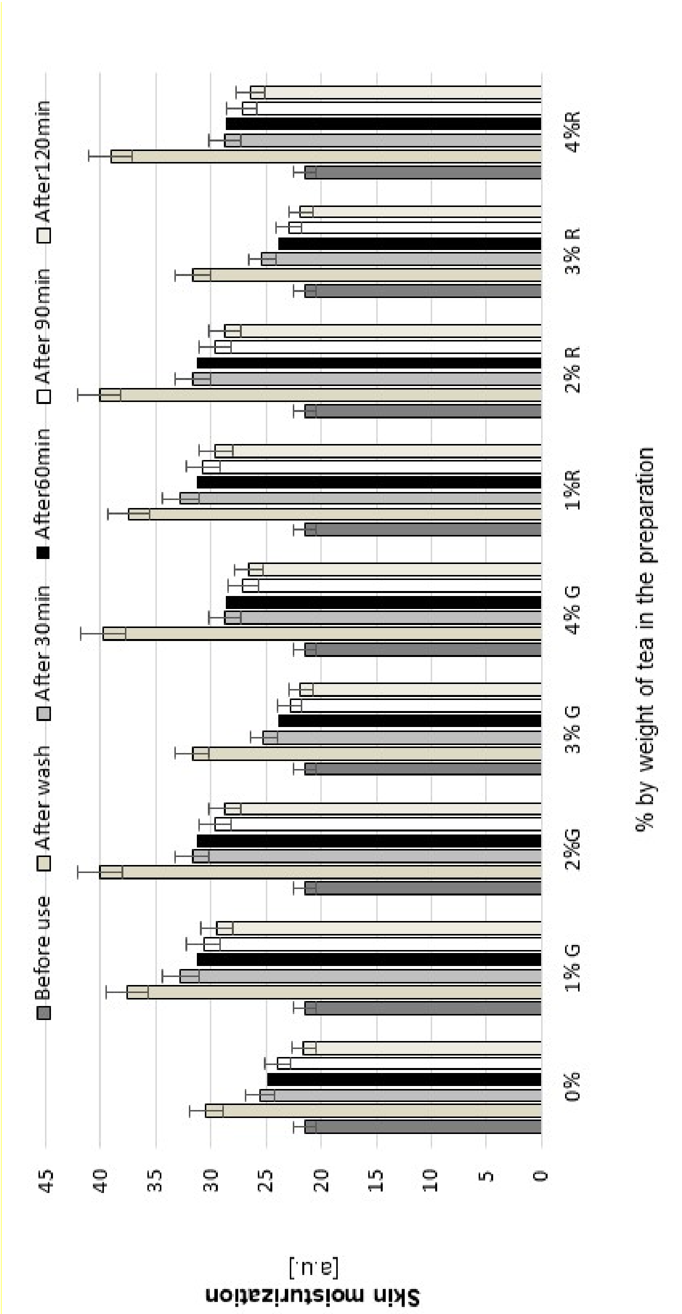

Fig. 4. Skin moisturization of original face care masks with red and green tea moisturization, G-green tea, R-red tea, T = 22°C (n = 3, +/- SD)

Before the application of the masks, the degree of skin moisturization was low, at 21.4 a.u. For the mask without the addition of teas, the skin moisturization immediately after washing off the mask was 30 a.u then by 120 minutes it had dropped again to a value of about 21 a.u. It can be seen that the addition of both red and green tea has a positive effect on the increase in skin moisturizing levels. The highest level of moisturization occurs immediately after washing off the masks, at about 40 a.u., and after two hours it remains at an average level of about 30 a.u. in the case of masks with either red or green tea. On the other hand, there was no significant difference in skin moisturization between preparations with different concentrations of teas, while the type of tea used did not affect this parameter.

3.5. Sensory assessment

Sensory assessment is a useful tool for cosmetic product improvement and quality control in the cosmetics industry. This method can be used for quick and inexpensive measurements of cosmetic effectiveness (market research and consumer testing), information on optimization of various product features, selection of the best product from a larger group of products, testing the durability of cosmetics, and the introduction of new ingredients into formulations. In recent years, one can observe a trend of developing "customized cosmetics", i.e. tailored to individual consumer needs. Formulation design is a complex process, in which the physicochemical and functional characteristics of the product must also be optimized in terms of the subjective feelings and sensory impressions of future buyers.

Sensory evaluation is essential for the assessment of the effects and optimization of the cosmetic formulations. Sensory evaluation was performed in order to determine how acceptable the cosmetics are to potential consumers. The results shown in the charts represent the arithmetic mean calculated from evaluation scores given by 10 testers.

Figure 5 shows the sensory analysis for the original masks containing powdered green tea. A sensory analysis of cosmetic masks containing red and green tea showed that the tested properties, such as consistency homogeneity, adhesion, cushion effect, smoothness, and spreading of the masks, scored the most points for both red and green masks. Also, the red and green tea masks made showed no stickiness effect and absorbed at the 2-point level. Therefore, it was considered that the results for green tea masks would be presented representatively.

All formulations showed very good adhesion. This means that the samples are easy to pick up with a finger from the jar. A very good result was obtained by all masks in terms of consistency and homogeneity. These parameters determine the quality of the emulsions – whether they are smooth, without bubbles, as well as the consistency and density of the cosmetic. The score obtained indicates that all the criteria were met.

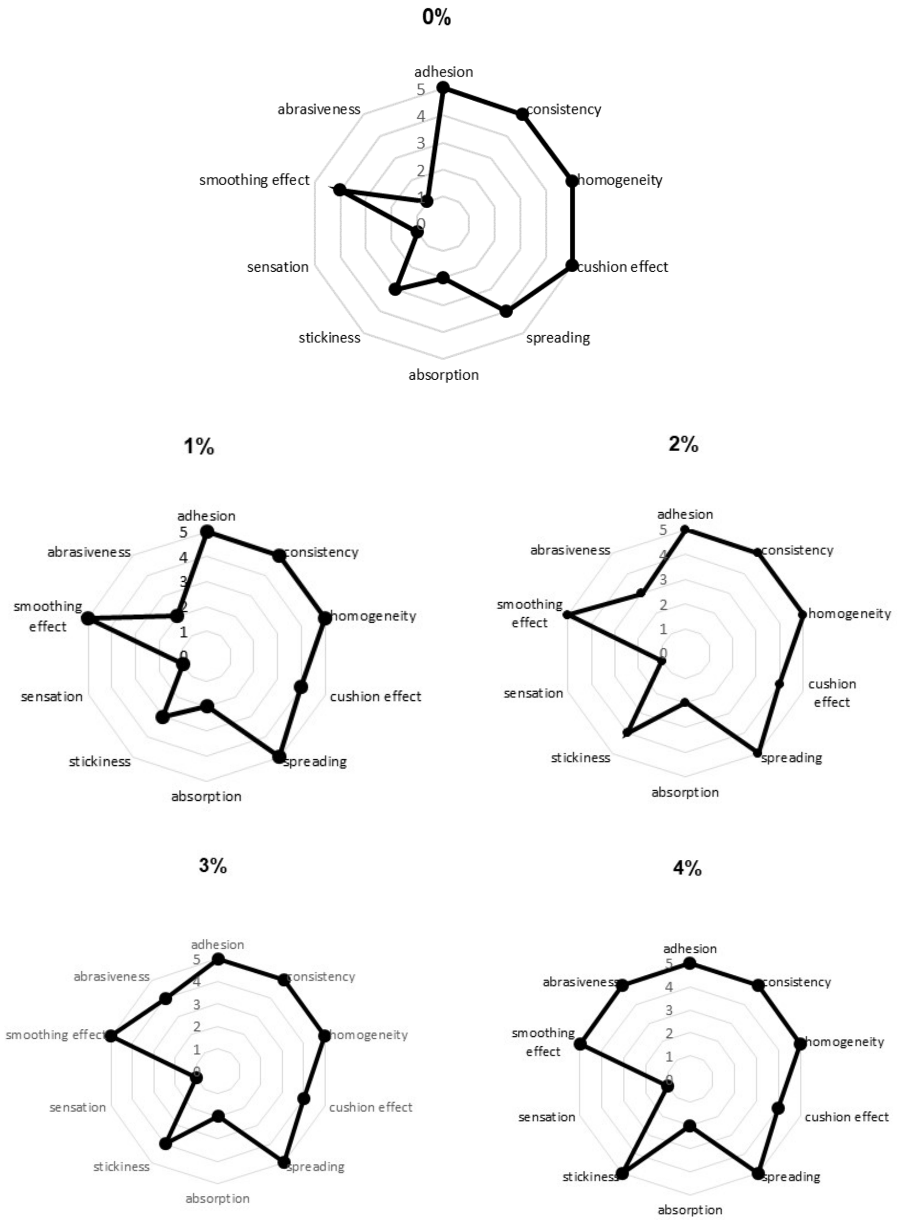

Fig. 5. Sensory assessment of original face care masks with powdered green tea, T = 22°C (n = 3, +/- SD)

On the other hand, the cushion effect, which determines the amount of preparation felt between the fingers when rubbing them together, was strongest for the base sample. Preparations containing tea had this effect one grade lower. The ease of spreading the product improved when tea grounds were added.

For the base sample, the spreadability was at a good level, and the test samples – regardless of tea concentration – showed a very good result. Absorption of the product into the skin was rated inadequate, which was due to the nature of the product. Cosmetic masks are applied in a thick layer to the face and then rinsed off – these products do not completely absorb into the face. In the case of stickiness, that is, the degree to which the cosmetic leaves a sticky layer on the skin, the greatest differences were found among all the parameters tested. The base mask and 1% were rated at a sufficient level, 2% and 3% at a good level, and 4% at a very good level. The degree of leaving an oily film on the skin immediately after product application in all samples was determined to be inadequate, meaning that the masks do not leave an oily film. The smoothing effect was one degree higher in the masks with the addition of tea than in the base mask. The peeling properties of the cosmetic were stronger with the concentration of tea in the product.

4. CONCLUSIONS

The conducted research indicates that the introduction of powdered waste red and green tea leaves into masks makes it possible to obtain full-fledged cosmetic products with good usage properties. The original masks were characterized by the viscosity and yield point required for this type of cosmetics. In practice, this means the good application of the product on the skin and its spreadability on the skin surface. In addition, the introduction of powdered tea leaves resulted in an increase in skin hydration up to two hours after the application of the mask in relation to the base mask. However, there were no differences in skin moisturizing by the type of tea used, as both red and green tea masks showing comparable moisturizing properties.

The sensory tests conducted corresponded well with the laboratory tests. Respondents found the tea-containing masks' low greasiness sensation and low absorption to be beneficial, as the mask is usually applied as a thicker layer and washed off the skin after application. Consistency, uniformity, cushion effect and skin smoothing spreadability were also highly rated. The introduction of leaf teas additionally gave a good exfoliating effect, making the cosmetic not only a care product but also a multifunctional one.

The research presented in the paper can be a valuable compendium of knowledge for cosmetics manufacturers and increased awareness of the use of waste raw materials in this group of products. Due to the use of waste raw materials and consumer safety, it would be worthwhile in the future to expand usability testing to include microbiological testing of both teas and finished cosmetics.

REFERENCES

Anchisi, C., Meloni, M.C., Maccioni, A.M., 2006, *Chitosan Beads Loaded with Essential Oils in Cosmetic Formulations*, Journal of Cosmetics Science, vol. 57, no. 3, pp. 205–214.

Bazinet, L., Labbe, D., Tremblay, A., 2017, *Production of Green Tea EGC- and EGCG-Enriched Fractions by a Two-Step Extraction Procedure*, Separation and Purification Technology, vol. 56, no. 1, pp. 53–56.

Bujak, T., Zagórska-Dziok, M., Ziemlewska, A., Nizioł-Łukaszewska, Z., Wasilewski, T., Hordyjewicz-Baran, Z., 2021, *Antioxidant and Cytoprotective Properties of Plant Extract from Dry Flowers as Functional Dyes for Cosmetic Products*, Molecules, vol. 26, pp. 2809–2834.

Dmowski, P., Śmiechowska, M., Karwowska, K., 2011, *Wpływ czasu parzenia na zawartość wybranych składników bioaktywnych w herbatach pu-erh*, Zeszyty Naukowe Uniwersytetu Ekonomicznego w Poznaniu, no. 205, pp. 52–59.

Draelos, Z., 2005, *Cosmeceuticals, Cosmetic Dermatology*, Elsevier M. V Inc., London.

Grys, A., Łowicki, Z., Gryszczyńska, A., Kania, M., Parus, A., 2011, *Rośliny zielarskie w leczeniu chorób skóry – bezpieczeństwo i zastosowanie*, Postępy Fizjoterapii, no. 2, pp.191–196.

Khomowa, V., Gusakova, S.D., Nigmatullaev, A., 1997, *Lipids of Mentha spicata*, Chemistry of Natural Compounds, vol. 33, pp. 630–632.

Klimaszewska, E., Małysa, A., Zięba, M., Rój, E., Wasilewski, T., 2016a, *Zastosowanie hydrofobowego ekstraktu z nasion jeżyny otrzymywanego przez ekstrakcję nadkrytycznym ditlenkiem węgla do wytwarzania maseczek kosmetycznych*, Przemysł Chemiczny vol. 95, no. 6, pp. 1000–1005.

Klimaszewska, E., Małysa, A., Zięba, M., Wasilewski, T., 2016b, *Korelacje między zawartością regulatorów konsystencji a właściwościami fizykochemicznymi i użytkowymi maseczek pielęgnacyjnych zawierających ekstrakt z nasion jeżyny otrzymywany w warunkach nadkrytycznego ditlenku węgla,* [in:] Wasilewski, T., Klimaszewska, E. (eds.), *Zastosowanie ekstraktów roślinnych pozyskiwanych w warunkach nadkrytycznego CO_2 w kosmetykach i produktach chemii gospodarczej*, Wydawnictwo Uniwersytetu Technologiczno-Humanistycznego w Radomiu, Radom.

Klimaszewska, E., Seweryn, A., Małysa, A., Zięba, M., Lipińska, J., 2018, *The Effect of Chamomile Extract Obtained in Supercritical Carbon Dioxide Conditions on Physicochemical and Usable Properties of Pharmaceutical Ointments*, Pharmaceutical Development & Technology, vol. 28, no. 8, pp. 780–786.

Klimaszewska, E., Zięba, M., Gregorczyk, K., Markuszewski, L., 2021, *Application of Blue Honeysuckle Powder Obtained by an Innovative Method of Low-Temperature Drying in Skincare Face Masks*, Molecules, vol. 23, no. 26, pp. 7184–7201.

Kulawik-Pióro, A.., Klimaszewska, E., Ogorzałek, M., Ruman, J., Rożnawska, K., 2000, *Effectiveness of Protective Preparations: Impact of Vegetable Oil Additives to Recipes*, European Journal of Lipid Science and Technology, vol. 122, no. 12, pp. 130–142.

Labbe, D., Tremblay, A., Bazinet, L., 2006, *Effect of Brewing Temperature and Duration on Green Tea Catechin Solubilization: Basis for Production of EGC and EGCG-Enriched Fractions*, Separation and Purification Technology, vol. 49, no. 1, pp. 1–9.

Małysa, A., Zatorska, M., 2022, *Assessment of Usage Properties of Bodycare Emulsions Containing Oils from Waste Raspberry and Pumpkin Seeds*, [in:] Ruszkowska, M. (ed.), *Innovations in Development of Products and Services*, vol. 2, Wydawnictwo Uniwersytetu Morskiego w Gdyni, Gdynia.

Meyer, R., 2005, *Delivery System Handbook for Personal Care and Cosmetic Products*. Technology, Applications and Formulations, William Andrew Publishing, New York.

Michorczyk, P., Vogt, O., Ogonowski, J., 2015, *Analiza składu chemicznego ekstraktów z wybranych surowców roślinnych uzyskanych w nadkrytycznym* CO_2, Przemysł Chemiczny, vol. 94, no. 8, pp. 1316–1320.

Moghtader, M., 2013, *In Vitro Antifungal Effects of the Essential Oil of Mentha piperita L. and Its Comparison with Synthetic Menthol on Aspergillus niger*, African Journal of Plant Science, vol. 7, no. 11, pp. 521–527.

Ribeiro, A.S., Estanqueiro, M., Lobo, M., 2015, *Main Benefits and Applicability of Plant Extracts in Skin Care Products*, Cosmetics, vol. 2, no. 2, pp. 48–65.

Samber, N., Varma, A., Manzoor, N., 2014, *Evaluation of Mentha piperita Essential Oil and Its Major Constituents for Antifungal Activity in Candida spp*, International Journal of Innovative Research in Science Engineering and Technology, vol. 3, pp. 9404–9421.

Sułek, M.W., Małysa, A., Totoń, M., 2012, *Kształtowanie jakości maseczek do cery suchej poprzez właściwy dobór ich składu*, *Selected aspects of cosmetics and household chemistry products quality*, Wydawnictwo Naukowe Instytutu Technologii Eksploatacji – PIB, Radom.

Zague, V., Silva, D., Baby, A.R., Kaneko, T.M., Velasco, M.V.R, 2007, *Clay Facial Masks: Physicochemical Stability at Different Storage Temperatures*, Journal of Cosmetic Science, vol. 29, no. 6, pp. 488–489.

Zięba, M., 2023, *Kształtowanie jakości maseczek do twarzy poprzez wprowadzenie do receptur wybranych proszków roślinnych pozyskiwanych z rodzimych upraw*, [in:] Bocho-Janiszewska, A., Zięba, M. (eds.), *Problemy jakości w badaniach i praktyce*, Sieć Badawcza Łukasiewicz – Instytut Technologii Eksploatacji, Radom.

Zięba, M., Małysa, A., Wykrota, M., 2015, *Zastosowanie kawy jako naturalnego ścierniwa w peelingach do ciała*, Towaroznawcze Problemy Jakości, vol. 42, no. 1, pp. 121–134.