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THE COMMODITY ASPECTS OF USING OAT BRAN AND WHEAT BRAN IN COSMETIC SCRUBS

Anna Małysa
Kazimierz Pulaski University of Radom, Chrobrego 27, 26-600 Radom, Poland,
Faculty of Applied Chemistry, ORCID 0000-0002-1220-0179, e-mail: a.malysa@urad.edu.pl

Abstract: The aim of the research was an attempt to apply waste raw materials (oat bran and wheat bran) to cosmetic scrubs. On the basis of literature reports and our own research, original formulations were developed for cosmetics containing the additives in question as an abrasive. The developed cosmetics were in an anhydrous form and contained vegetable fats and skin-sensitive surfactants. Only upon use did they come into contact with water and form an emulsion that, after abrading the epidermis, took care the skin. The reference point in the evaluation was a high-quality commercial product. The functional properties of the obtained cosmetic prototypes were evaluated: stability, viscosity, yield point, skin moisturization, and sensory analysis of the developed formulations. Based on the study, it was found that scrubs containing the addition of oat bran had more favourable rheological and sensory properties, and showed a higher degree of skin moisturization two hours after washing the product off the skin, compared to a commercial product.

Keywords: oat bran, wheat bran, cosmetic scrubs, face care, waste raw materials.

1. INTRODUCTION

One of the basic treatments to maintain the condition of the skin and exfoliate keratinized epidermis is the use of peels (intended to exfoliate). We can understand a peel as a cosmetic procedure as well as a cosmetic product (scrub). A scrub involves the removal of dead skin cells, or sometimes also the top layer of the epidermis, in order to remove imperfections and lesions of the skin. As a result of the exfoliation procedure, the skin can be thoroughly cleansed, smoothed, brightened and regenerated faster. The skin becomes tighter, firmer and has a better skin tone. Important in peels is the type of abrasive substance used. The abrasive contained in the cosmetic stimulates microcirculation, which causes the body to redden after the treatment. The skin is better supplied with nutrients and oxygen, since the cleansed skin more effectively absorbs the active ingredients of cosmetics, and makes it easier to moisturize. There are three types of peeling: mechanical, chemical and physical. The most popular, due to their availability and ability to be carried out at home, are mechanical peels. They involve the mechanical abrasion of dead skin with the help of various cosmetics containing abrasives. This type of scrub can come in the form of gels, pastes, suspensions, as well as emulsions and microemulsions, and can be designed for the skin of the face and the entire body [Sułek, Małysa and Totoń 2012; Zięba, Małysa and Wykrota 2015].

Manufacturers in the cosmetics industry have been interested in recent years in sourcing and using waste raw materials from the food industry in cosmetics. They are guided by the reduction of production costs, the acquisition of active raw materials with a specific effect that are safe to use, that reduce waste generation, as well as take the form of environmental protection, which all form part of the implementation of the goals for sustainable development and the "zero waste" trend. The primary materials used are vegetable oils, cellulose, seeds, plant fibers, starch, coffee, pomace and bioferments. The introduction of a new raw material into cosmetic formulations makes it possible to obtain innovative products; however, it is often associated with a change in their physicochemical properties, which in turn translates into convenience of use for the product. Therefore, there is a need for specialized research into new products related to their usability and functionality, in order to provide the consumer with a product of the highest quality [Ribeiro, Estanqueiro and Lobo 2015; Wasilewski et al. 2021; Małysa 2024].

This paper proposes the use of oat and wheat bran as abrasive substances for cosmetic scrubs. These raw materials can form an alternative to synthetic microparticles due to their health-promoting and cosmetic properties.

The aim of the study was to introduce wheat bran from oats and wheat into cosmetic scrub formulations and to analyze the correlation between the content of these ingredients in the formulation and the parameters of stability, viscosity, yield point, moisturization, and sensory properties, which have a decisive influence on the functional properties of the cosmetics.

2. EXFOLIATING SUBSTANCES IN COSMETIC SCRUBS

Granular peels, classified as mechanical peels, have in their composition an abrasive responsible for removing imperfections, impurities and dead cells of the stratum corneum. Classification of mechanical abrasives contained in this type of cosmetics can be done by origin, between natural and synthetic.

Abrasives of natural origin include:

- brown rice – contains ingredients that protect the skin from hyperpigmentation and oxidation;
- coffee – coffee beans or extracts are commonly used in slimming treatments, they have anti-cellulite properties;
- lotus seeds – regenerate the epidermis and inhibit the negative effects of free radicals;

- nuts – are a source of antioxidants and vitamin E;
- dried and crushed cranberry fruit – forms a source of polyphenols, strengthening the epidermis and the hydrolipidic protective layer of the skin, thus supporting its protective properties;
- micronized algae – have many valuable ingredients for the skin, including microelements, alginic acid, sorbitol, carbohydrates, polysaccharides, proteins, and unsaturated fatty acids;
- sea salt – is a source of minerals;
- cane sugar – reduces the diffusion and evaporation of water from the skin.

The ground natural raw materials are hard and sharp, so it is important that the size of the friction grains is properly selected, as the scrub could cause excessive redness and irritation of the skin. Scrubs with abrasives of natural origin exfoliate the skin very effectively.

Scrubs containing synthetic and semi-synthetic particles are more gentle, as the abrasive particles are characterized by a regular shape and are softer compared to abrasives of natural origin. This group of abrasives includes polymeric granules (most often polyethylene), jojoba beads, waxes (rice, carnauba), pumice particles, and ground aluminum oxide [Meyer 2005; Zięba, Małysa and Wykrota 2015].

Synthetic microparticles, usually in the form of polyethylene, are used by the cosmetic industry as an abrasive and filler due to their specific properties and durability. As a synthetic substance, they raise some controversy, especially on the topic of microplastics and their impact on the environment. The controversy surrounding polyethylene stems from the perception that synthetic polymers are microplastics that pollute the environment and can be ingested by aquatic organisms, among other things. The two most common forms of polyethylene in cosmetics, based on particle size, are the high-molecular-weight polyethylene found in cosmetics in the form of microbeads, as used in skin scrubs and exfoliating products, and a low-molecular-weight polymer that takes a liquid form and acts as a filler, binder and stabilizer [Ogorzałek et al. 2024].

In addition to mechanical exfoliating agents, chemical substances that produce an exfoliating effect can be distinguished. Due to the mode of action, these substances include those that destroy the skin cells and, as a result, cause exfoliation of the dead layers of the epidermis. Such an action includes salicylic acid, which causes superficial exfoliation and allows easier penetration of substances into the epidermis. Depending on the concentration, it has a keratolytic (dissolving or breaking down the protein structures of the stratum corneum, specifically keratin) or cytotoxic (cell damage and death) effect, trichloroacetic acid (abbreviated as TCA) – the depth of exfoliation actually depends on the concentration of this acid, although it easily penetrates the epidermis and dermis. It produces a cytotoxic effect, causes coagulation of proteins and cell death due to low pH, and resorcinol which causes a cytotoxic effect. The latter works by superficial exfoliation of the epidermis due to denaturation of proteins and cell death, which cause a change in cell metabolism, and then leads to exfoliation. This group of chemicals includes glycolic acid, which causes superficial exfoliation. This acid inhibits enzymes that affect the formation of ionic bonds between corneocytes, and also affect cell division in the living layers of the epidermis. Mandelic acid is stronger in action than glycolic acid, causing superficial exfoliation. Lactic acid, used in concentrations of up to 10%, has a moisturizing effect, while in higher concentrations it causes superficial exfoliation. Pyruvic acid determines superficial exfoliation. Retinoic acid, a vitamin A derivative, causes divisions in the basal layer of the epidermis, the synthesis of collagen and glycosaminoglycans, smoothing the skin and improving its color [Draelos 2005; Meyer 2005; Tufail et al. 2022].

3. CEREAL BRAN – HEALTH-PROMOTING AND COSMETIC PROPERTIES

Although bran is produced as a by-product of the milling industry, during the production of flours and groats, it is a very valuable ingredient in dietary supplements and food products. They are especially valued as a product that is a source of dietary fiber. Bran consists of a fruit casing and an aleurone layer with a seed casing, as well as an admixture of shredded germ and endosperm. Although the most popular types of bran include those formed from oats, wheat or rye (oat bran, wheat bran, rye bran, respectively), they are also produced from other plants.

Therefore, rice bran, spelt bran, corn bran and even buckwheat bran are also available on the market. Bran contains a wealth of vitamins, especially the B group vitamins, unsaturated fatty acids, as well as minerals like phosphorus, iron, magnesium, copper, selenium, and zinc [Tufail et al. 2022].

The nutritional properties of bran are shown in Table 1.

Table 1. Nutritional values of bran

Value per 100 g of product/product	Oat bran	Wheat bran	Rye bran	Corn bran	Rice bran
Energy value	246 kcal	216 kcal	281 kcal	224 kcal	316 kcal
Carbohydrates	66.22 g	64.51 g	26 g	85.64 g	46.69 g
Protein	17.3 g	15.55 g	15 g	8.36 g	13.35 g
Fat	7.03 g	4.25 g	4 g	0.92 g	20.85 g
Dietary fiber	15.4 g	42.8 g	39 g	79 g	21 g
Vitamin A	–	9 IU	–	71 IU	–
Vitamin E	1.01 mg	1.49 mg	–	0.42 mg	4.92 mg
Vitamin K	3.2 μg	1.9 μg	–	0.3 μg	1.9 μg
Vitamin B1	1.17 mg	0.523 mg	–	0.01 mg	2.753 mg

cont. Table 1

Vitamin B2	0.22 mg	0.577 mg	–	0.1 mg	0.248 mg
Vitamin B3	0.934 mg	13.578 mg	–	2.73 5mg	33.995 mg
Vitamin B4	32.2 mg	74.4 mg	–	18.1 mg	32.2 mg
Vitamin B5	1.494 mg	2.181 mg	–	0.636 mg	7.39 mg
Vitamin B6	0.165 mg	1.303 mg	–	0.152 mg	4.07 mg
Vitamin B9	52 μg	79 μg	72 μg	4 μg	63 μg
Sodium	4 mg	2 mg	–	7 mg	5 mg
Potassium	566 mg	1182 mg	900 mg	44 mg	1485 mg
Calcium	58 mg	73 mg	–	42 mg	57 mg
Magnesium	235 mg	611 mg	300 mg	64 mg	781 mg
Phosphorus	734 mg	1013 mg	750 mg	72 mg	1677 mg
Ironsite	5.41 mg	10.57 mg	9 mg	2.79 mg	18.54 mg
Copper	0.403 mg	0.998 mg	–	0.248 mg	0.728 mg
Zinc	3.11 mg	7.27 mg	8 mg	1.56 mg	6.04 mg
Manganese	5.63 mg	11.5 mg	–	0.14 mg	14.21 mg

Source: [Bituykova et al. 2019].

Bran has a beneficial effect on the human body and, for this reason, it can be considered a health-promoting component of the diet. It should be remembered that bran is primarily a valuable source of fiber, as component that plays a very important role in maintaining health and the proper functioning of the digestive system. Bran contains both water-insoluble fiber and soluble fiber. Insoluble fiber easily absorbs water, gives a feeling of satiety, and facilitates the movement of food content in the intestines. This type of fiber prevents constipation, and its regular consumption is associated with the prevention of hemorrhoids and colon cancer.

On the other hand, soluble fiber fractions play an important role in lowering blood cholesterol levels. Therefore, regular consumption of bran can be important in the prevention of atherosclerosis and cardiovascular disease. Bran also has soothing, moisturizing, skin-cleansing properties, so it can be a valuable ingredient in cosmetic formulas. When used in cosmetics, they soothe irritated skin, reduce redness and relieve inflammation. Oat bran can also be used effectively in hair care, thanks to its nourishing and strengthening properties [Lentini et al. 2022; Tufail et al. 2022].

Wheat bran could be a potential ingredient source in the cosmetics industry due to their functional properties, including emulsion stability, skin-whitening effects, and antimicrobial capabilities. Wheat bran could be utilized in some cosmetic formulations, offering natural and effective alternatives to synthetic ingredients. Wheat-bran-derived lipids have been found to enhance the stability of emulsions, and emulsions from natural sources are in high demand in cosmetic formulations [Bituykova et al. 2019]. The emulsions with wheat-bran-derived lipids demonstrated higher emulsion stability (49.17–52.33%) compared with the control emulsion made with soybean oil (46.00%). This indicates that the addition of wheat-bran lipids enhances the stability of an emulsion without causing particle separation. This study found that the skin-whitening effect of the emulsions increased with the concentration of wheat-bran-derived lipids. These findings indicate the potential application of wheat-bran-derived lipids in the cosmetics sector.

Wheat bran extract may enhance skin hydration, softness, and smoothness. These extracts are particularly beneficial in skincare formulations, as well as in shampoos and scalp treatments. Previous research indicates that the combination of wheat bran extract with carboxylic acid alkyl ester and diol enhances combability, shine, elasticity, volume, and shape retention and minimizes damage.

Moreover, ferulic acid encompasses a multitude of prospective therapeutic applications, functioning as a scavenger of free radicals and serving as a protective agent against ultraviolet radiation-induced skin damage. Research has determined that there exists an amount of up to 5157 ±66 mg of alkali-extractable ferulic acid per kilogram of dry destarched wheat bran. Phycocyanobilin exhibits potential benefits for the human skin, including wrinkle reduction and anti-inflammatory properties. Research indicates that phycocyanobilin extract from marine Arthrospira maxima possesses skin anti-wrinkling effects linked to antioxidant activity and decreased intracellular reactive oxygen species. Notably, the anti-wrinkling effects of phycocyanobilin extracts are markedly amplified by incorporating wheat bran, achieving up to a 20–30% enhancement across different concentrations, likely due to the synergistic interaction of soluble globulins and other bioactive compounds in wheat bran [Lentini et al. 2022; Kobayashi et al. 2025].

Oat bran, particularly xylo-oligosaccharides (XOS) and protein hydrolysates, have demonstrated strong antioxidant capacities. These extracts inhibit such enzymes as collagenase, elastase, and hyaluronidase, which are associated with skin aging. The inhibition of these enzymes suggests potential applications in cosmetic products aimed at reducing skin wrinkles and maintaining skin elasticity. The phenolic content in oat bran has been shown to significantly inhibit hyaluronidase activity, reaching up to 49.9% inhibition at a concentration of 0.5 mg/mL. This highlights the potential of oat bran in developing functional ingredients for anti-aging cosmetics [Bituykova et al.2019].

The oat-derived ingredients were reported to function in cosmetics as antioxidants, skin conditioning agents, absorbents, and bulking agents. Based on a review of the literature, it was found that bran has not been used in cosmetics as an abrasive substance to date. However, there are cosmetic products on the market in the form of emulsions containing alcohol, glycol extracts and macerates from bran, as well as lipids obtained from bran. A survey was conducted by the Personal Care Products Council (Council) of the maximum use concentrations for these ingredients reported by industry. Oat Extract was reported to be used in face and neck spray products in concentrations up to 0.0025% and Oat Protein in pump hair sprays in concentrations up to 0.001%. Oat Extract-containing products are used medically as dermal moisturizers and to treat itchy skin due to dryness, poison ivy/oak/sumac, and insect bites as well as to treat acne. Other reported skin-barrier-related effects include the formation of a protective moisturizing barrier by the proteins and polysaccharides in colloidal oatmeal, which reduced transepidermal water loss. Colloidal oatmeal has also been shown to act as an emollient, humectant, and occlusive on the skin.The application of oat extracts to sodium lauryl sulfate–treated skin has been reported to reduce irritation, demonstrating the anti-inflammatory effects of oats and suggesting potential benefits for the skin barrier [Vie et al. 2002; Vansina et al. 2010].

4. MATERIALS AND METHODS

4.1. Recipes for cosmetic scrubs

Based on literature reports [Kulawik-Pióro et al. 2000; Meyer 2005; Klimaszewska et al. 2016; 2018; Bujak et al. 2021; Wasilewski et al. 2021; Małysa and Zatorska 2022; Zięba 2023; Małysa 2024; Ogorzałek et al. 2024] and our own research, formulations of waterless cosmetic scrubs were developed.

Raw materials were used for the application of the scrubs, names according to the INCI nomenclature: Butylospermum Parkii Butter, 100% (Bioorganic Concepts), Cocos Nucifera Oil, 100% (Swanson), Argania Spinosa Kernel Oil – 100% (Ecco Verde), Almond Oil – 100% (Olvita), Polysorbate – 80–100% (Sigma Aldrich), Glycerine –100%, (Pure Chemical), Oat Bran (Piątnica), and Wheat Bran (DMBio).

Scrub recipes varied in the type and content of the bran. Formulations designated as S1 or S2, contained 14 wt% and 16 wt% oat bran, respectively.

On the other hand, samples designated as S3 or S4 contained 14 wt. % and 16 wt. % wheat bran. The presented cosmetic scrub formulations do not contain water, only fatty substances and emulsifiers, thus limiting the growth of microorganisms and increasing the shelf life of the preparations, without the need for preservatives, as confirmed by the compositions of similar products available on the market. The skincare effect is only achieved at the moment of use, when an emulsion is formed after applying the scrub to the skin and adding water. In addition, rubbing the product on the skin removes dead skin cells and smooths the skin.

The formulations are shown in Table 2.

Table 2. Recipes of original cosmetic scrubs

INGREDIENTS (INCI) / RECIPE	% by weight			
	S 1	S 2	S 3	S 4
Butylospermum Parkii Butter	40			
Cocos Nucifera Oil	10			
Argania Spinosa Kernel Oil	8			
Almond Oil	12			
Polysorbate -80	12			
Glycerin	4			
Avena Sativa Bran (Oat Bran)	14	16	-	
Triticum Vulgare Bran (Wheat Bran)	-		14	16

Source: own study.

4.2. Procedure for obtaining cosmetic peels

Cosmetic scrubs were obtained according to the following procedure. Shea butter (Butylospermum Parkii Butter), coconut oil (Cocos Nucifera Oil), argan oil (Argania Spinosa Kernel Oil), almond oil (Almond Oil), non-ionic surfactant (Polysorbate – 80) and glycerine (Glycerine) were introduced into a glass vessel, heated at 50^{o}C to melt the ingredients, then mixed to a homogeneous consistency. Wheat bran and oat bran were ground to dust for 20 seconds in a Vevor grinder. The particle size of the ground bran ranged from 100–250 µm, which, according to available literature data, ensures a good exfoliating effect in scrubs. The fat mixture was cooled to room temperature, then the ground bran was added, and then the whole mass was mixed.

4.3. Characteristic of trade product

The reference point for evaluating the original preparations was the waterless product from Ziaja.

The characteristics of the scrub designation as TP are shown in Table 3. Despite its different composition, the commercial product served as a reference point because it had the same effect on the skin as the peel obtained in the laboratory. It also did not contain water, only fatty substances and emulsifiers, and when combined with water during use, it formed an emulsion that had a conditioning effect on the skin.

Table 3. Characteristic of trade cosmetic scrubs

Sample designation	Ingredients	Package capacity [ml]	The producer's description present on the label
TP	Sucrose, Paraffinum Liquidum (Mineral Oil), Cera Microcristallina (Microcrystalline Wax), Cera Alba (Beeswax), PEG-7 Glyceryl Cocoate, Elaeis Guineensis (Palm) Oil, Isopropyl Myristate, Parfum (Fragrance), Cetearyl Alcohol, Butyrospermum Parkii (Shea) Butter, Hydrogenated Castor Oil, Synthetic Wax, Cocos Nucifera (Coconut) Oil, CI 42090 (Blue 1 Lake), CI 16035 (Red 40 Lake), CI 15985 (Yellow 6 Lake), Lecithin, Benzotriazolyl Dodecyl p-Cresol, CI 16035 (FD&C Red No. 40)	300	Caramelized scrub with an iconic marshmallow scent. Smooths skin with natural sugar crystals. The aromatic care leaves your skin smooth, soft and deliciously fragrant

4.4. Stability

This test allows you to determine 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 the samples under the influence of temperature changes. The sample is held in a hothouse at 40ºC, and then in a refrigerator at 4ºC. This cycle was repeated alternately for 24 hours over a period of 7 days. The centrifuge test was performed in a TD-4 laboratory centrifuge. The scrubs samples were placed in 15 ml test tubes and filled with the preparation to 2/3 of their capacity. The centrifuge test was performed at a speed of 4000 rpm for 15 minutes. After the test, the samples were left for 10 minutes to stabilize the air bubbles, and then a visual assessment of the samples was performed. In the stability tests, three replicates were performed for each sample [Klimaszewska et al. 2016].

4.5. 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].

4.6. Yield Point

The values of the yield point of the tested cosmetic scrubs were determined using a Brookfield HA DV III Ultra viscosity meter equipped with a set of vane spindles (vane spindle). Measurements were carried out at a constant spindle speed 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].

4.7. 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 occurring 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. Tests for original and commercial products were performed on the skin of the forearm. Twenty people took part in the skin moisturization test. The resulting scrubs were tested on a group aged 20–25. From the given values, the arithmetic mean was calculated for each sample [Zięba 2023].

4.8. Sensory assessment

The main purpose of 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 effect. The evaluation was conducted on 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. The resulting scrubs were tested on a group aged 20–25 years. Three measurements were taken for each sample [Ogorzałek et al. 2024].

5. RESULTS

5.1. Effect of oat and wheat bran on selected functional properties of cosmetic scrubs

5.1.1. Stability

The stability and appearance of the tested scrubs is a very important aspect for further research and a criterion for consumer choice of the product. Tests conducted on the formulations made according to the developed recipes showed that they were stable and did not delaminate. No sinking to the bottom of the abrasive was noticed, which is a characteristic sign of instability in this type of product. Therefore, it can be concluded that the addition of oat and wheat bran does not adversely affect their stability during storage at varying temperatures. The centrifugation test also yielded positive results, as the formulations did not separate.

5.1.2. Viscosity

The appropriate dynamic viscosity value (η) of a cosmetic product can be achieved by using the right amount of fillers (excipients) or viscosity regulators, as well as the content of active ingredients. The correct viscosity of the product facilitates its application and spreading on the skin. The viscosity of the scrub was measured on a Brookfield viscometer at 5 rpm.

The results obtained are presented in Figure 1.

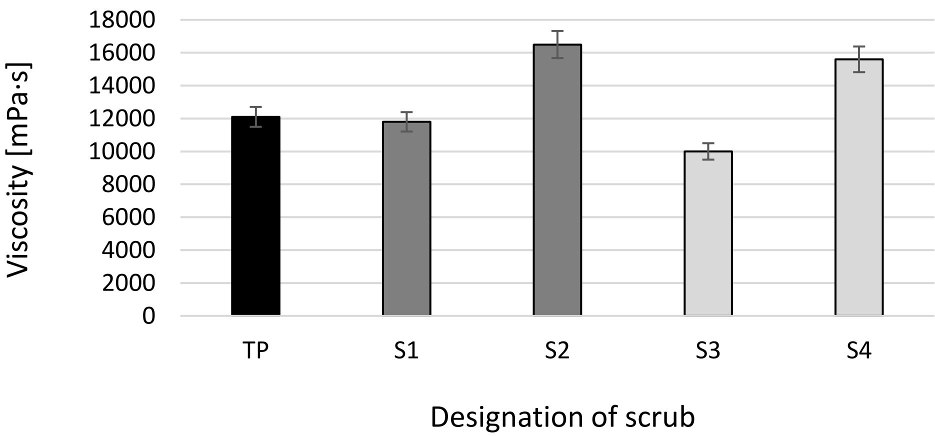

Fig. 1. Viscosity of the original scrub care with oat, wheat bran and a trade product, T = 22^{o}C (n = 3, +/- SD)

For the trade scrub, without the addition of bran, a viscosity of about 12 100 mPa · s was recorded. The addition of oat and wheat bran at a concentration of 14 wt% to the scrubs does not significantly affect the viscosity of the formulations relative to the market product. For the original cosmetics, viscosity values were recorded as follows: 11 800 mPa · s (S1) and 10 000 mPa · s (S3). On the other hand, higher values of η were obtained at higher bran content (16 wt%), which were 16 500 mPa · s (S2) and 15 600 mPa · s (S4), respectively. The presented tests correspond very well with the yield point (Fig. 2).

5.1.3. Yield point

The final appearance of a product is influenced by many issues, one of which is the study of yield point of the given scrubs, which verifies the type of packaging or the way in which the scrub will be applied to the skin or used by consumers. The evaluation of this parameter in a peel is important because of the dosage and spreading of the product on the surface of the skin. A relatively low yield point makes it easier to dispense the product while too high makes it difficult to apply.

The measurement results are shown in Figure 2.

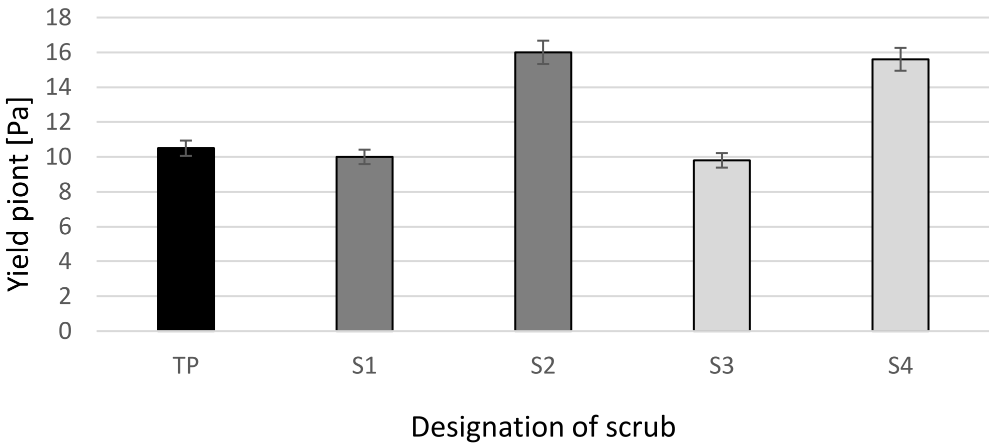

Fig. 2. Yield point of the original scrub care with oat, wheat bran and a trade product, T = 22°C (n = 3, +/- SD)

The addition of both bran from oat and wheat at a concentration of 14 wt% to the scrubs has little effect on the yield point relative to the commercial product (10.5 Pa). The results for this parameter were comparable, and were within experimental error. A yield point value of 10 Pa was recorded for a cosmetic with oat bran, while a value of 9.8 Pa was recorded for one containing wheat bran. However, an increase in yield stress was observed for concentrations of 16 wt%

in the formulation. They were 16.0 Pa for the oat bran scrub (S2) and 15.6 Pa for the wheat bran cosmetic (S4), respectively. Increasing the yield stress for this type of cosmetic can, in practice, makes it difficult to extract the cosmetic from packaging, such as in the form of a tube, or negatively affects the distribution of the cosmetic on the skin surface.

5.1.4. Skin moisturization

The test was conducted to assess skin moisturization by measuring the water content of the stratum corneum. The effect is based on electrical conductivity: the more water the skin's stratum corneum contains, the better the current flows, which means a higher level of skin moisturization.

The measurement results for the original scrubs and the commercial product are shown in Figure 3.

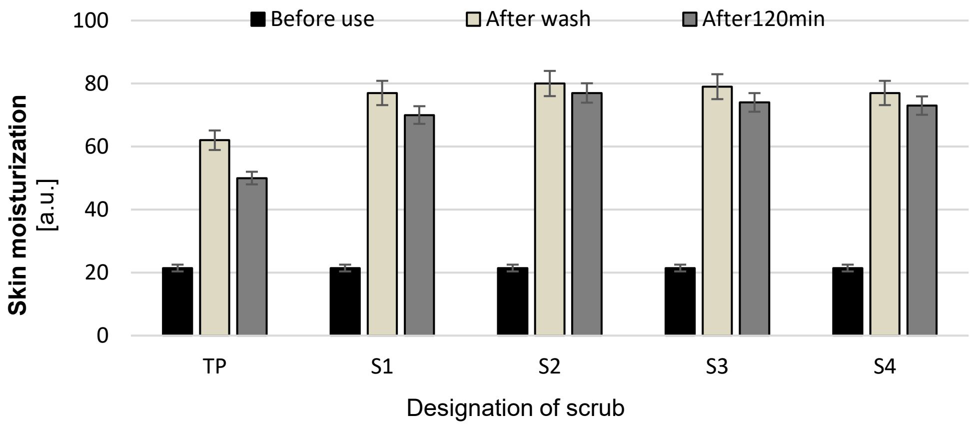

Fig. 3. Skin moisturization of the original scrub care with oat bran, wheat bran and a trade product, T = 22°C (n = 3, +/- SD)

Before the application of the scrub, the degree of skin moisturization was low, at 21.4 a.u. For the trade scrub, the skin moisturization immediately after washing off the cosmetic was 62 a.u. Then, after 120 minutes, the skin hydration value decreased to 50 a.u. The research presented here indicates that the original scrubs containing the addition of both oat and wheat bran show higher levels of skin moisturization compared to the market product. Immediately after washing off the product, skin moisturization levels were very high, in the range 77–80 a.u.

On the other hand, 120 minutes after washing off the cosmetic, the moisturization level was also relatively high, in the range 70–77 a.u. The high level of skin moisture after using the original scrubs is due to the specially composed composition of the scrub, which contains vegetable fatty substances and an emulsifier. When it comes into contact with water, an emulsion is formed, which moisturizes the skin after the application of the cosmetic and allows the skin to maintain a high level of moisturization in the epidermis for a longer period of time.

5.1.5. 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 introduction of new ingredients into formulations. In recent years, one can observe a trend toward 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 graphs represent the arithmetic average calculated from the ratings given by the 10 testers. Figure 4 shows the sensory analysis for the original scrubs containing oat and wheat brans and, as a reference, the sensory analysis for the commercial product.

The probands found that all of the original scrubs and the commercial product were homogeneous, and therefore received the maximum note in the tests of 5 points. Relatively low parameter values were recorded for the commercial product due to the testers finding that the product not meeting the required spreadability and adhesion to the skin, which made it difficult to apply from the package. In addition, it did not create a cushion effect, and showed a poor abrasion and smoothing effect on the skin after application.

Good sensory test results were obtained for the original products containing 14 wt.% oat bran (S1) and 14 wt.% wheat bran (S3). All the tested parameters were rated at 4 and 5 points, so they received the approval of the majority of the test probands. Preparations S2 and S4 were characterized by high sensory parameters. The testers rated such characteristics as smoothness, consistency, homogeneity, abrasiveness, and spreadability at 5 points. These products did not exhibit excessive stickiness or absorb into the skin, which are desirable effects for scrubs.

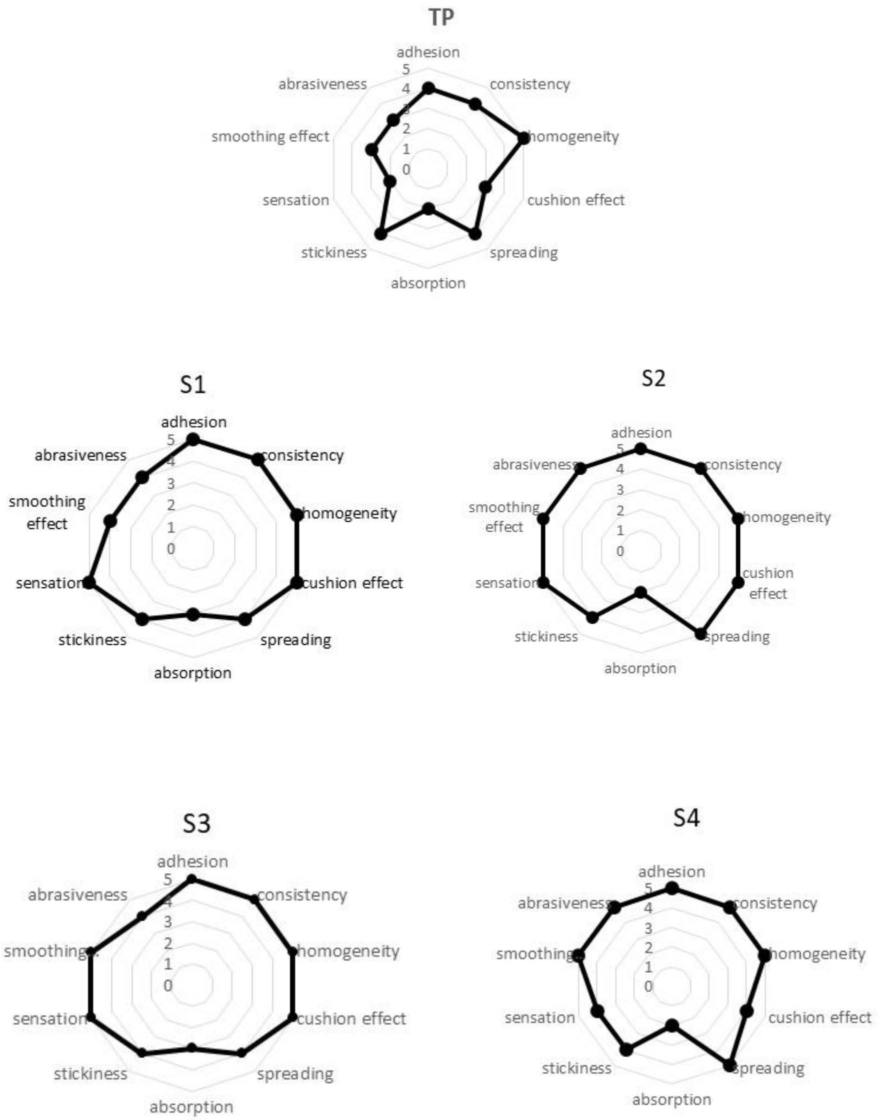

Fig. 4. Sensory assessment of original scrubs with oat bran, wheat bran and a trade product

6. CONCLUSIONS

The research indicates that the introduction of powdered wheat and oat bran into cosmetic scrubs makes it possible to obtain full-fledged cosmetic products with good functional properties. The original scrubs were characterized by the viscosity and yield point required for this form of cosmetics, comparable to the commercial product. In practice, this means good application potential for the product on the skin and its spreadability on the skin surface. The viscosity and yield point results obtained may also indicate the possibility of using different types of cosmetic packaging, depending on the concentration of bran in the formulation. For concentrations of 14 wt.%, at lower values of viscosity and melt limit it is more preferable to use packaging in the form of a tube, while for concentrations of 16 wt.% by weight in the formulation packaging it is preferable to use packaging in the form of a jar. This choice will ensure better dispensing of the product from the package.

Moisturization tests were performed based on literature data, which established that 120 minutes after application of the product is sufficient to assess the moisturizing effectiveness of the cosmetic. Skin moisturization tests showed that the original scrubs moisturized the skin better immediately after washing the preparation with water and after 2 hours compared to the commercial product. Skin moisturization tests showed that the original scrubs moisturized the skin better immediately after washing off the product with water and after 2 hours compared to the commercially available product. Effective skin moisturization indicates that the developed cosmetics have a skin conditioning effect.

The abrasive content had a decisive impact on the application parameters of the cosmetics obtained. The laboratory tests conducted corresponded well with the sensory consumer evaluation tests. Scrubs with a higher abrasive content (16% by weight) showed better spreadability on the skin in sensory tests compared to preparations with a 14% by weight abrasive content. The developed products also showed more favourable application characteristics compared to commercial products, particularly in terms of consistency, homogeneity, cushioning effect, exfoliation, and skin smoothing. A good exfoliating effect was obtained, making the cosmetic not only a care product, but also a multifunctional one.

The research presented in this paper may be considered a valuable compendium of knowledge for cosmetic manufacturers and allow one to increase the awareness of the use of waste raw materials in this group of products.

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