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The Method of Studying Cosmetic Creams Based on the Principles of Systems Theory and Mathematical Modeling Techniques

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Abstract: This paper reviews research on some cosmetic creams considered "distributed parameters systems" and on the experimental-computational mathematical models that have been determined for them. The determined models characterize the cosmetic creams in all stages of the manufacturing process, starting with the development of recipes, the description of raw materials, manufacturing technologies, and the determination of the physico-chemical and microbiological indicators that most strongly influence their quality. This approach suggests the possibility of performing optimization operations, specifically sensitivity analyses, which may lead to the identification of best quality indicators and to the amelioration of negative effects related to disturbance sizes (temperature, pressure, humidity etc.). Five emulsions with different compositions, prepared in vitro according to our own recipes, using raw materials and preparation methods approved for cosmetic products, were studied. Through specific physico-chemical and microbiological analyses, we obtained databases that were processed computationally. The resulting mathematical models, in the form of both graphs and equations, led to important conclusions regarding obtaining high quality in the studied creams and to the confirmation of the usefulness of applying the principles of Systems Theory to the study of cosmetic products.

Keywords: cosmetic cream; distributed parameters systems; mathematical model; quality indicators

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1. Introduction

The development of the cosmetic industry in recent years, almost all over the world, has led to increasing competitiveness in terms of placing cosmetic creams of the highest qualities at affordable prices for customers on the market. As a result, companies producing cosmetics are constantly concerned with improving the quality and presentation of the finished product, competitiveness being the main factor increasing the profits in the field of marketing. Every cosmetic company has at least one auxiliary research laboratory independent of the production premises. Its role is important in the general marketing of the company because research related to the improvement of product quality is carried out here by optimizing the development of manufacturing recipes and their validation to ensure good traceability of the products in the future.

The quality of a cosmetic cream is usually assessed in specific laboratories using classical methods, such as physico-chemical, microbiological and organoleptic analyses.

This paper reviews research carried out on some cosmetic emulsions through the prism of Systems Theory, and particularly, the use of mathematical modeling methods [1,2].

In Figure 1, the cosmetic emulsion is represented as a "system with distributed parameters" (macrosystem) [3].

As can be seen, the system has the input variables u (independent variables: time, raw materials of the aqueous phase, raw materials of the oily phase, active ingredients, fragrance, and rheological parameters of the raw materials), the output variables y (dependent variables: organoleptic indicators, evaporation loss—PE, evaporation residue—RE, pH, stability, peroxide index, saponification index, secondary oxidation products, density, viscosity, concentration of active ingredients, total number of germs—NTG, staphylococcus aureus, pseudomonas aeruginosa, and yeasts and molds) and perturbation sizes z (temperature, pressure, humidity, and homogenization).

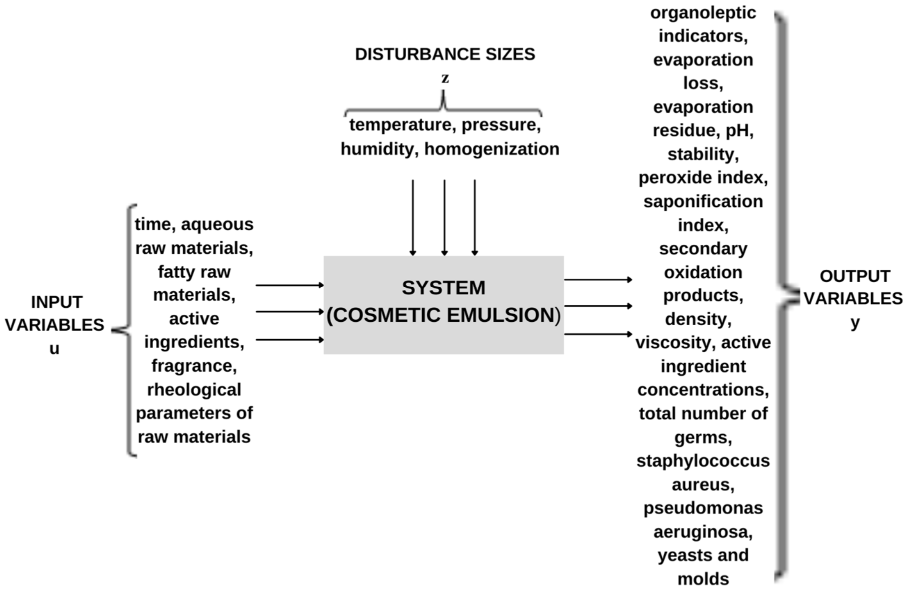

Figure 1. Representation of the cosmetic emulsion as a system.

For modeling techniques, the mathematical equations used are in the form of y = f(u,z) in accordance with the proposed definition of a mathematical model [4]. To determine dependency relationships using y = f(u,z), the following types of mathematical models [4] are employed:

- Analytical or theoretical models based on knowledge of physico-chemical laws, as well as physico-chemical processes that govern the state and evolution of the studied system. When determining these types of models, a series of simplifying assumptions are adopted, logically justified by the particular analysis system. Here, the model is determined after laborious procedures and is usually characterized by complex systems of higher order matrix equations.
- Experimental or statistical models based on the correlation of experimental data.
- Using these data, equations that describe the relationships between the output variables and the input variables are determined based on the principles of mathematical statistics and regression analysis. These dependencies are usually expressed by polynomial equations of different orders. Mathematical expressions amenable to automatic calculation are used directly in practical applications as well as in experimental research.
- Mixed or analytical-experimental models derived from both the existing dependence relationships between the output and the input variables, as well as through the statistical processing of the experimental data. Most of the time, these mathematical models are much simpler; however, they show lower precision in relation to the real system.
- Due to the fact that the studied cosmetic emulsion (Figure 1) has an increased number of in/out variables, the f function of the theoretical model has high complexity, and we used experimental-computational mathematical modeling techniques. The other reason for using this mathematical model is to reduce the cost of raw materials.

- According to Figure 1, there are multiple subsystems and initially three distinct and different phases: oily, aqueous, and solid. After the homogenations process and obtaining the actual emulsion, the result will be a homogeneous mixture, characterized by the output variables values. These output variables are in fact quality indicators that influence the final result of a performant cosmetic emulsion.
- Considering the above mentioned mathematical modeling techniques, in this paper we studied using the principles of Systems Theory [1–4] a series of emulsions/creams prepared according to our own recipes (E1–E4), as well as the "Remineralizing antiwrinkle cream" (E5) produced (and released on the market) by Virago Beauty SRL, Faget, Romania.

The results obtained by our team in previous research [5] have demonstrated that the experimental-computational mathematical models determined for these emulsions (E1–E4) allowed their characterization in very convenient conditions for their transition to mass production (E5).

In this paper, experimental-computational mathematical models have been determined, which were used to define the dependencies between three quality indicators (NTG, pH, RE) for E1–E4 emulsions, respectively, relative density (d), pH and evaporation loss (PE) for E5 emulsion.

The database used was taken from the experimental measurements monthly performed on creams E1–E4, at established dates, for 4 years. Regarding E5 cream, we used the database extracted from the report from the accredited laboratory Genmar Cosmetics SRL, Bucharest, Romania, required in the product file of the "Remineralizing antiwrinkle cream" in order to release it on the market.

The 3D graphical representations, the mathematical equations representing experimental-computational models and the values of the adequacy indicators were obtained using the computational program Statistica 14.0.

The efficiency of this study has a major impact on obtaining high quality products, through a concrete prediction for the optimal indicators values, that confer the desired quality for cosmetic emulsions (physico-chemical and microbiological stability, adhesion to the tissue skin, antitoxicity, etc.).

2. Materials and Methods

2.1. Materials

The E1–E5 emulsions composition is:

Emulsion E1: water, paraffin oil, petrolatum, cetearyl alcohol, methylparaben, sodium lauryl sulfate, glycerin, fragrance, spirulina, tocopherol.

Emulsion E2: water, paraffin oil, petrolatum, cetearyl alcohol, glycerin, methylparaben, sodium lauryl sulfate, fragrance, tocopherol.

Emulsion E3: water, paraffin oil, petrolatum, cetyl alcohol, glycerin, methylparaben, Theobroma cacao seed butter, sodium lauryl sulfate, honey, fragrance.

Emulsion E4: water, paraffin oil, petrolatum, cetyl palmitate, stearic acid, cetearyl alcohol, methylparaben, sodium lauryl sulfate, glycerin, honey, fragrance, tocopherol, retinyl palmitate.

Emulsion E5 (Remineralising antiwrinkle cream): water, coco-caprylate/caprate, cetearyl olivate, sorbitan olivate, *Vitis vinifera* (grape) seed oil, *Helianthus annuus* (sunflower) seed oil, *Glycine soja* (soybean) oil, *Olea europaea* (olive) fruit oil, *Butyrospermum parkii* butter, *Theobroma cacao* seed butter, glycerin, Saccharomyces/zinc ferment, Saccharomyces/copper ferment, Saccharomyces/magnesium ferment, Saccharomyces/iron ferment, Saccharomyces/silicon ferment, Lactobacillus ferment lysate, *Camellia sinensis* leaf extract, *Punica granatum* extract, caffeine, vegetable collagen, cetearyl alcohol, *Imperata cylindrica* root extract, sodium hyaluronate, benzyl alcohol, chlorphenesin, parfum/fragrance, sodium benzoate [6].

All the component ingredients of the prepared emulsions are presented in Table 1 along with their functions.

Table 1. The functions of ingredients in the prepared emulsions.

Ingredients	Functions	Reference
Stearic acid	Surfactant, emulsifying, emollient, emulsion stabilizing	[7–11]
Cetyl alcohol	Surfactant, emulsifying, emollient, emulsion stabilizing, viscosity controlling	[7,11]
Cetearyl alcohol	Surfactant, emulsifying, emollient, emulsion stabilizing, viscosity controlling, opacifying	[7,11,12]
Cetyl palmitate/Cetaceum	Skin conditioning—emollient	[7,11]
Cetearyl olivate	Skin conditioning—emollient, emulsifying, emulsion stabilizing	[7]
Sorbitan olivate	Surfactant—emulsifying	[7]
Sodium lauryl sulfate	Surfactant—cleansing, emulsifier, foaming agent	[7,11,13]
Theobroma Cacao Seed Butter	Skin conditioning agent—miscellaneous, skin protecting, emollient and moisturizer, anti-inflammatory properties	[7,9,11,14,15]
Butyrospermum Parkii Butter	Skin conditioning, skin protecting, emollient and moisturizer	[7,11]
Petrolatum/Vaseline	Skin conditioning—emollient, moisturizer	[7,11,16]
Paraffinum liquidum /Paraffin oil	Skin protecting, fortifying the natural moisture barrier (occlusive emollient)	[7,11,17]
Coco-caprylate caprate	Skin conditioning—emollient	[7]
Vitis vinifera seed oil	Skin conditioning—emollient	[7]
Helianthus annuus seed oil	Skin conditioning—emollient, skin conditioning—miscellaneous, skin conditioning—occlusive, solvent	[7]
Glycine soja oil	Skin conditioning—emollient	[7]
Olea europaea fruit oil	Skin conditioning	[7]
Glycerin	Humectant, skin conditioning—miscellaneous, skin protecting, solvent, viscosity controlling	[7,11]
Methylparaben/Methyl 4-hydroxybenzoate	Preservative	[7]
Benzyl alcohol	Preservative	[7]
Chlorphenisin	Antimicrobial, preservative	[7]
Sodium benzoate	Preservative	[7]
Water/aqua	Solvent	[7]
Saccharomyces/copper ferment	Skin conditioning	[7]
Saccharomyces/iron ferment	Skin conditioning	[7]
Saccharomyces/silicon ferment	Skin conditioning	[7]
Saccharomyces/zinc ferment	Skin conditioning	[7]
Saccharomyces/magnesium ferment	Skin conditioning	[7]
Lactobacillus ferment lysate	Skin conditioning	[7]

Table 1. *Cont.*

Ingredients	Functions	Reference
Camellia Sinensis leaf extract	Antioxidant, skin conditioning—emollient, skin protecting, humectant, antimicrobial, tonic	[7]
Punica Granatum extract	Astringent, tonic	[7]
Caffeine	Skin conditioning	[7]
Vegetable collagen	Moisturizing, skin conditioning	[7]
Imperata Cylindrica root extract	Skin conditioning	[7]
Sodium hyaluronate	Humectant, skin conditioning	[7]
Spirulina	Antioxidant	[7]
Honey	Humectant, skin conditioning	[7]
Tocopherol	Antioxidant	[7]
Retinyl palmitate	Skin conditioning	[7]

2.2. The Emulsions Preparation

Preparation of test samples E1–E4 was carried out according to the O/W emulsion technology [18–22]. Thus, in the first stage, both the aqueous phase composed of distilled water and water-soluble compounds (glycerin, methylparaben, sodium lauryl sulfate) and the oily phase composed of fat-soluble compounds (paraffin oil, vaseline, cetearyl alcohol, cocoa butter, stearic acid, cetaceum) were heated to 80 °C. Then, in the second stage, the aqueous phase was added over the oily phase and mixed for 10 min with a Lab High-shear Homogenizer at 10,000 rpm. The emulsions were cooled to 35 ÷ 40 °C after homogenization, under continuous stirring at 5000 rpm. Then, the active ingredients and the fragrance were added.

Emulsion E5 was prepared using the method presented previously, with the following specifications for phase composition:

- The aqueous phase contains: water, glycerin, sodium benzoate;
- The oily phase contains: coco-caprylate/caprate, cetearyl olivate, sorbitan olivate, *Vitis vinifera* (grape) seed oil, *Helianthus annuus* (sunflower) seed oil, *Glycine soja* (soybean) oil, *Olea europaea* (olive) fruit oil, *Butyrospermum parkii* butter, *Theobroma cacao* seed butter, cetearyl alcohol, benzyl alcohol, chlorphenesin;
- The third phase contains the active ingredients: Saccharomyces/zinc ferment, Saccharomyces/copper ferment, Saccharomyces/magnesium ferment, Saccharomyces/iron ferment, Saccharomyces/silicon ferment, Lactobacillus ferment lysate, *Camellia sinensis* leaf extract, *Punica granatum* extract, caffeine, vegetable collagen, *Imperata cylindrica* root extract, sodium hyaluronate;
- The fourth phase contains the perfume.

Overall, 1kg was prepared for each E1–E4 emulsion, so as to ensure the weight used in all the physico-chemical and microbiological analyzes carried out monthly for 4 years, as well as for the counter-testing samples.

The E1–E4 emulsions were packed in boxes with removable lids and E5 in airless boxes. All bottles were stored in a special room with the temperature (15 ÷ 25 °C) and air humidity (55 ÷ 65%) continuously monitored. The samples subjected to physico-chemical and microbiological analyzes were extracted from these boxes in the amount of 10 g each.

The pH values were measured with the InoLab pH meter (model WTW inoLab pH 7110) and the evaporation residue (RE) was measured with the PCE-MA 50X thermobalance. The total number of germs NTG was determined using the WTG colony counter type BZG30. The measuring instruments were used in accordance with recommendations regarding calibration and precision mentioned in the documents accompanying the devices at the time of their purchase.

It is noted that all reagents used in the above assays were purchased from Sigma-Aldrich.

Physico-chemical and microbiological parameters were determined with specific analytical methods recommended by current standards [20,23].

Figure 2 shows the finished product "Remineralizing anti-wrinkle cream" available on the market.

Figure 2. Finished product on the market, "Remineralizing antiwrinkle cream" [6].

2.3. Methodology Used to Determine Experimental-Computational Mathematical Models

Computational modeling was used for the 5 emulsions, as a technique to obtain the mathematical equations, going through the following steps:

- Obtaining experimental databases by measuring the following quality indicators values: evaporation residue RE, total number of germs NTG, pH, relative density d, evaporation loss PE;
- The processing of experimental data obtained in the laboratory was carried out with the software Statistica 14.0, version with multiple linear regression method and Microsoft Excel, version with nonlinear regression method. Thus, both 3D and 2D graphical representations and the corresponding mathematical equations and the values of adequacy indicators were obtained.
- The experimental-computational mathematical models were tested based on the calculated adequacy indicator values: dispersion σ^2, standard deviation σ, model accuracy indicator R^2 and root mean square error RMSE [24];
- Authenticity of the model was checked with the classical method of calculating the absolute error E [5].

3. Results

3.1. Dependence of Evaporation Residue (RE) on Total Number of Germs (NTG) and pH for the Emulsions E1–E4, Followed for 4 Years

The results obtained for the four emulsions taken in the study are presented in the form of graphs in 3D format (Figure 3a–d) and tables that include the mathematical equations that represent the experimental-computational models (Table 2), the values of the indicators of adequacy (Table 3) and the calculated absolute errors (Table 4).

Table 2. The equations of mathematical models for emulsions E1–E4.

Type of Emulsion	Equation
E1	$RE = 1.1921 \cdot pH - 0.0551 \cdot NTG + 36.7193$
E2	$RE = -0.0045 \cdot pH - 0.0214 \cdot NTG + 40.322$
E3	$RE = -1.4821 \cdot pH - 0.1116 \cdot NTG + 46.6188$
E4	$RE = 3.5920 \cdot pH - 0.1323 \cdot NTG + 11.5651$

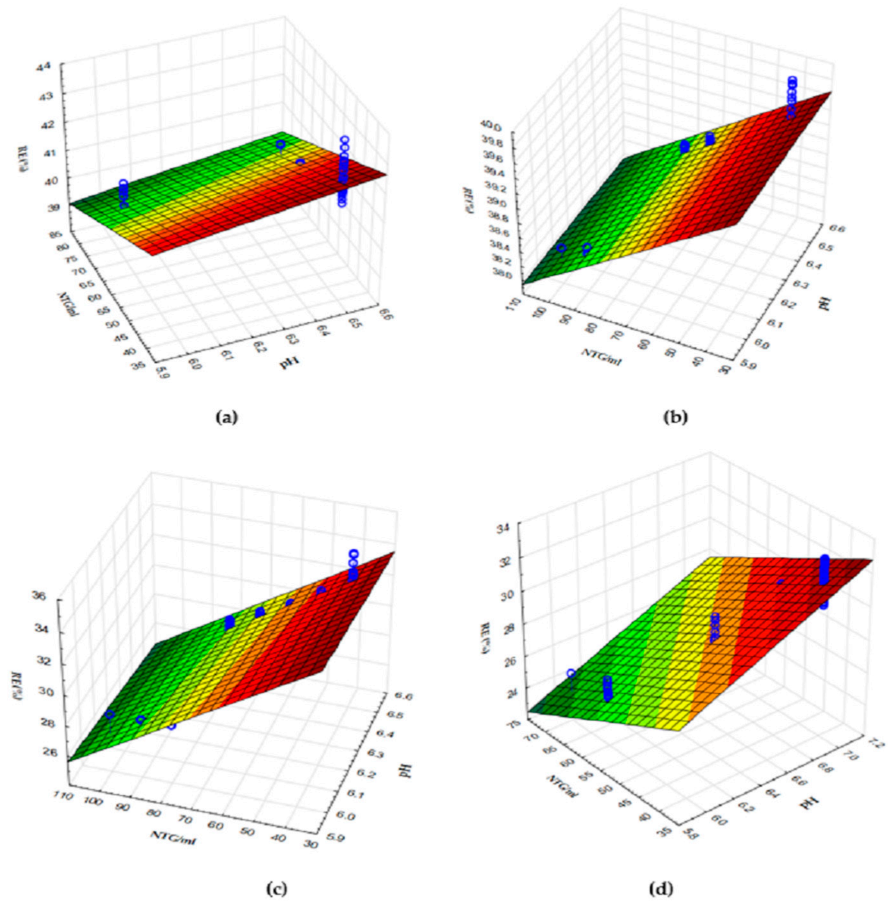

Figure 3. Dependence of RE vs. NTG and pH for the emulsions (**a**) E1; (**b**) E2; (**c**) E3; (**d**) E4.

Table 3. The adequacy indicators for emulsions E1–E4.

Type of Emulsion	Dispersion σ^2	Standard Deviation σ	Model Accuracy Indicator R^2	Root Mean Square Error RMSE
E1	0.2696	0.5193	0.7646	0.0726
E2	0.0362	0.1903	0.8189	0.0266
E3	0.3485	0.5903	0.9113	0.0825
E4	0.9174	0.9578	0.8730	0.1338

Table 4. The absolute errors of the models obtained for emulsions E1–E4.

Type of Emulsion	TimeT, [Months]	Experimental RE, [%]	Calculated RE, [%]	Absolute Error Value, [%]
E1	1	43.66	42.26	3.31
	48	39.18	39.46	0.70
E2	1	39.92	39.43	1.24
	48	38.30	37.90	1.05
E3	1	34.20	32.52	5.17
	48	27.83	26.57	4.74
E4	1	32.83	31.42	10.35
	48	24.98	23.86	4.69

For emulsions E1–E4, the following notations are used: RE (%)—evaporation residue, pH, NTG/mL—total number of germs.

In order to verify the results obtained when determining the 3D graphs that show the shape of flat surfaces, the mathematical models that reflect the monitored parameter dependecies as a function of time were also determined. For this, the Microsoft Excel program was used, and the results obtained are presented in Figure 4a–d.

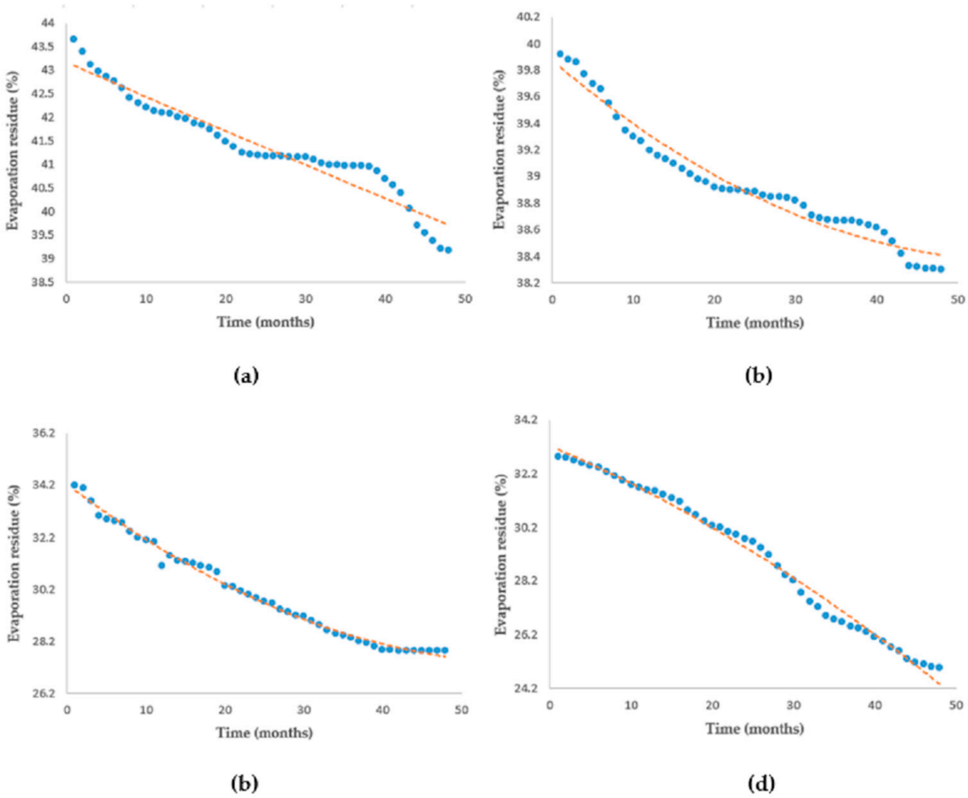

Figure 4. Variations of evaporation residue RE in time for emulsions (**a**) E1; (**b**) E2; (**c**) E3; (**d**) E4.

Mathematical model equations and calculated adequacy indicators for emulsion E1–E4 can be seen below (Table 5).

Table 5. The equations of mathematical models and the adequacy indicators for emulsion E1–E4.

Type of Emulsion	Equation	Model Accuracy Indicator R^2	Root Mean Square Error RMSE
E1	$RE = 4{\cdot}E^{-0.5}T^2 - 0.0737{\cdot}T + 43.172$	0.9241	0.0412
E2	$RE = 0.0005{\cdot}T^2 - 0.0523{\cdot}T + 39.877$	0.9583	0.0146
E3	$RE = 0.0019{\cdot}T^2 - 0.2302{\cdot}T + 34.234$	0.9921	0.0248
E4	$RE = -0.0012{\cdot}T^2 - 0.1294{\cdot}T + 33.252$	0.9900	0.038

3.2. Dependence of the Evaporation Loss (PE) on pH and Relative Density (d) for Emulsion E5 ("Remineralizing Anti-Wrinkle Cream" Virago Beauty), at 40 °C and 4 °C

The processing of the experimental data with the Statistica 14.0 program was carried out based on the multiple linear regression method.

The results obtained for the E5 taken in the study are presented in the form of graphs in 3D format (Figure 5a,b) and tables that include: the mathematical equations that represent the analytical-experimental-computational models (Table 6), the values of the indicators of adequacy (Table 7) and the calculated absolute errors E (Table 8).

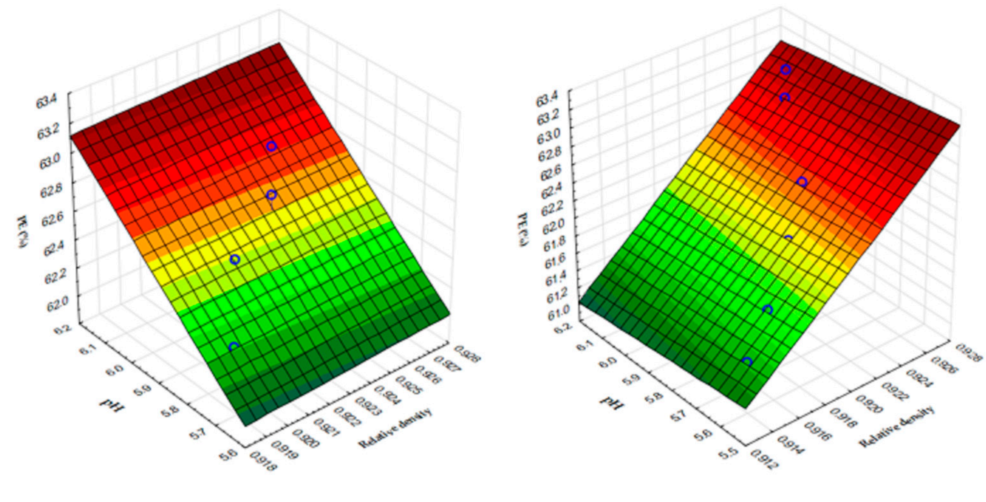

Figure 5. Dependence of PE vs. relative density and pH at (**a**) 40 °C; (**b**) 4 °C.

Table 6. The equations of mathematical models for emulsion E5.

Temperature, °C	Equation
40	$PE = 5.3706 \cdot d + 1.9416 \cdot pH + 46.1499$
4	$PE = 125.1937 \cdot d - 0.2819 \cdot pH - 51.4014$

Table 7. The adequacy indicators for emulsion E5.

Temperature, °C	Dispersion σ^2	Standard Deviation, σ	Model Accuracy Indicator, R^2	Root Mean Square Error RMSE
40	0.00563	0.0750	0.9713	0.0214
4	0.00134	0.0366	0.9971	0.0105

Table 8. The absolute errors of the models obtained for emulsion E5.

Temperature, °C	Time T, [Days]	Experimental PE, [%]	Calculated PE, [%]	Absolute Error Value, [%]
40	0	62.92	62.99	0.11
	8	61.99	62.95	1.52
4	0	62.92	62.89	0.04
	8	61.42	61.43	0.02

For the E5 emulsion, the following notations were used: PE (%)—evaporation loss, pH and d relative density.

The equations of the mathematical models and the adequacy indicators obtained for emulsion E5 are presented in Tables 6 and 7. Table 8 shows the absolute errors of the models obtained for emulsion E5.

The dependences between PE—evaporation loss, pH and relative density—d as a function of time for the E5 emulsion, with the same Microsoft Excel program, were determined.

Mathematical model equations and calculated adequacy indicators can be seen below (Table 9) and they are of the degree II polynomial form.

Table 9. Equations of the mathematical models and the calculated adequacy indicators.

Quality Indicators	Equations of the Mathematical Models	Model Accuracy Indicator, R^2	Root Mean Square Error RMSE
Evaporation loss at 40 ± 2 °C, %	$PE_{40} = 6E^{-0.5} \cdot T^2 - 0.0155 \cdot T + 62.932$	0.9994	0.0058
Evaporation loss at 4 ± 2 °C, %	$PE_4 = 0.0001 \cdot T^2 - 0.028 \cdot T + 62.857$	0.9934	0.0490
pH at 40 ± 2 °C	$pH_{40} = 5E^{-0.5} \cdot T^2 - 0.0095 \cdot T + 6.0929$	0.9843	0.0080
pH at 4 ± 2 °C	$pH_4 = 0.0001 \cdot T^2 - 0.0142 \cdot T + 6.0748$	0.9577	0.0148
Relative density at 40 ± 2 °C	$d_{40} = 1E^{-0.6} \cdot T^2 - 0.0002 \cdot T + 0.9266$	0.9942	0.00032
Relative density at 4 ± 2 °C	$d_4 = 1E^{-0.6} \cdot T^2 - 0.0003 \cdot T + 0.9263$	0.9934	0.00113

It can be seen from Figures 6–8 that the presented dependencies almost have a linear character, which is highlighted by the very small value of the term T^2 coefficient in the respective mathematical expression. As such, this is the plausible explanation for the linearity of the 3D dependences in Figures 3a–d and 5a,b.

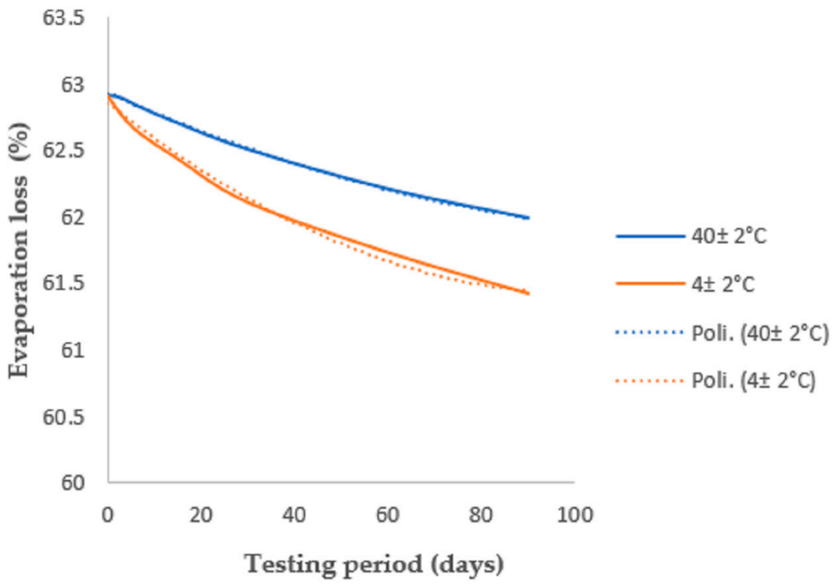

Figure 6. Variations of evaporation loss in time.

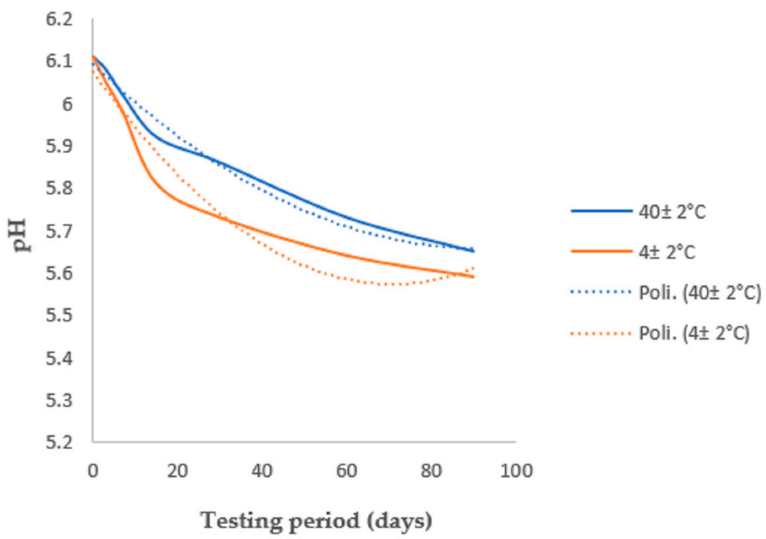

Figure 7. Variations of pH in time.

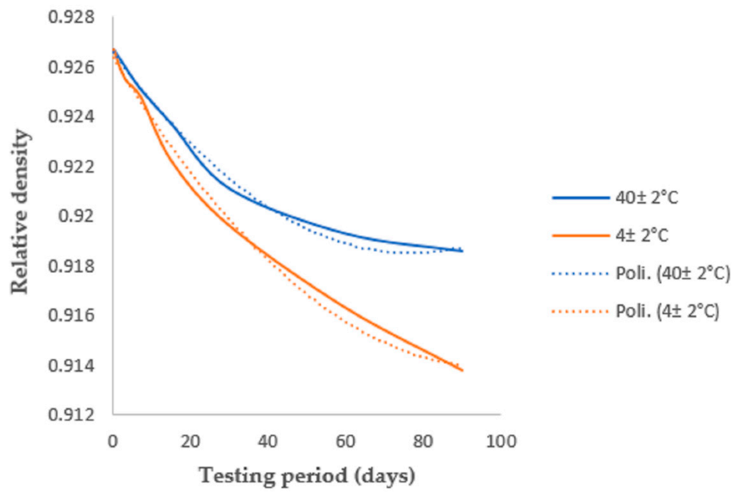

Figure 8. Variations of relative density in time.

4. Discussion

Taking into account the studies and research carried out regarding the application of the principles of Systems Theory and mathematical modeling techniques, the paper presents in detail the raw materials, production technologies, physico-chemical and microbiological analysis methods used in the manufacture of cosmetic emulsions according to our own recipes. We mention that some of the cosmetic products developed on the basis of these recipes were assimilated into series production and put on the market.

Regarding the concrete results on the mathematical models obtained for E1–E5, it can be observed that the graphs are presented in the form of flat surfaces. This was explained after, when determining the mathematical models and 2D graphs with appropriate software. It is observed that the obtained dependencies are polynomials of the second degree, but have a very small value of the coefficient at the quadratic term. So, this term can be neglected and, as a result, the mathematical description can be approximated with a linear one. This simplifying hypothesis can be applied to all descriptive mathematical models considering that their shape is strictly dependent on the type of the models that characterize the individual variations of the parameters tracked in the respective model.

The advantages of applying the principles of Systems Theory in the studies carried out to improve the quality indicators will be able to be used in the future to obtain higher quality emulsions, possibly by using innovative raw materials and active ingredients, as well as manufacturing recipes resulting from the basis of optimization operations, respectively, the selection in relation to the chosen scope function. It should be specified that the method presented is applicable only to a certain emulsion of a certain well-defined composition. The mathematical model determined for this in graphic form allows the determination of the values of other parameters directly from the representations obtained without the need for additional physico-chemical or microbiological analyses.

The results obtained from the characterization of the E5 emulsion through the completed mathematical models will be proposed to the Genmar Cosmetics laboratory to be used in the operations to determine the quality indicators without performing a multitude of physico-chemical and microbiological analyzes according to the current methodology. Also, these results can be taken over by other laboratories that have the status of issuing the necessary documents for approval and accreditation files for cosmetic products.

The quality studies were limited to monitoring the stability over time of the characteristic parameters for the analyzed cosmetic emulsions. The special qualities of the creams provided by the ingredients used (Table 1) are the following: reduction of facial expression wrinkles, increase in cellular energy and skin brightness, skin restructuring, filling of fine wrinkles reducing their appearance. No in vivo tests have been performed regarding the monitoring of the above-mentioned qualities.

5. Conclusions

The quality of the mathematical models obtained for the five emulsions, expressed by the values of the adequacy indicators, is acceptable, falling within the requirements of good accuracy of the model in relation to the real system. The obtained mathematical equations reflect with sufficient accuracy the behavior of real systems, namely cosmetic emulsions.

From the point of view of the efficiency of the study carried out, its practical importance must be revealed, manifested by determining the optimal quality indicators, a fact that leads to recommendations related to both the composition of the recipe and the manufacturing technology, storage, respectively, and the period of use by the customer (shelf life).

The study method applied in this work is comparable to the classical research methods of cosmetic emulsions based on direct experimental determinations with appropriate equipment. These classic methods do not offer the possibility of qualitative and quantitative evaluation of structural changes, evidenced by the form of graphic representations of the determined mathematical models. At the same time, the method addressed in the paper can replace the classic monitoring of cosmetic emulsion characteristic parameters, as well as allow predictions for the optimal values of quality indicators, which will ensure the physico-chemical and microbiological stability of cosmetic creams over time.

The applicative nature of the work is revealed by the creation of necessary documents for the marketing dossier of the "Remineralizing antiwrinkle cream" (Emulsion E5), which is already delivered to the final consumer.

Also, the processing of the database (physico-chemical analysis results) obtained in the report delivered by the laboratory of S.C. Genmar Cosmetics S.R.L., using mathematical modeling methods, respectively, Statistica 14.0 and Microsoft Excel calculation programs, allowed us to obtain graphs, equations of mathematical models and values of adequacy indicators.

Based on the mentioned findings, some recommendations can be made to the accredited specialized laboratories for testing and approving cosmetic products, especially emulsion creams, prepared according to the product recipes to be released on the market.

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