Sensory analysis of natural emulsifiers

Ailus, Jaana[1]; Poutanen, Marjo[2]; Viitala, Sari[2]
[1]*School of Pharmacy and Biomolecular Sciences, Liverpool John Moores University, UK;*
[2]*Laurea University of Applied Sciences, Finland*

INTRODUCTION

The rise in consumer demand for more natural cosmetics has been a growing trend in recent years. [1] This has spearheaded the development of increasingly advanced natural emulsifiers to better meet these requirements. [2] Previously only a few emulsifier options were available when formulating naturally certified cosmetics, and these all had limitations when it comes to sensorial properties. Due to numerous recent product launches, more options for texture and skinfeel are now available.

This paper looks at nine different naturally compliant emulsifying systems from various suppliers and compares their sensorial aspects. The objective of this study is to investigate the sensoriality of nine emulsions. They will be assessed in regard to absorption, play-time, spreadability, soaping and after-feel.

The result of this study will help in the selection of the most appropriate emulsifier. It will also provide nine easy frame formulations that can be modified to be used in finished products.

MATERIALS

At first nine simple emulsions were developed. They were named as E1, E2, E3 etc. All emulsions have the same base oil in the oil phase, stabilising agents and preservative system, and they only differ in the choice of emulsifier. The oil base and preservative system were chosen as they are easily available and easy to use in order to keep the focus on the emulsifiers.

Each sample contains 2,5-4 wt.% of different emulsifiers, amount depending on suppliers' instructions. The exact compositions of the samples are documented in the following frame formulations (including the trade name). Accelerated stability testing was performed on all emulsions to ensure a minimum of two years shelf-life.

The nine emulsions used in this study are listed here, with simple manufacturing instructions.

Emulsion 1

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,50%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Lecithin	BergaMuls SL Sun	Berg & Schmidt	3,00%
	Cetyl Alcohol	-	-	2,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 1

1. Heat phase A and phase B to 75°C
2. Pour phase B into phase A and homogenise for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 2

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,30%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Glyceryl Oleate Citrate	Easymuls Plus	Evonik	2,50%
	Cetyl Alcohol	-	-	1,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 2

1. Heat phase A and phase B to 75°C
2. Pour phase B into phase A and mix with and overhead stirrer at high shear for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 3

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,40%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Isostearyl Alcohol, Butylene Glycol Cocoate, Ethylcellulose	Emulfree CBG	Gattefosse	3,50%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 3

1. Heat phase A and phase B to 70°C
2. Pour phase B into phase A and mix with and homogeniser for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 4

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,30%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Glyceryl Stearate Citrate, Polyglyceryl-3 Stearate, Hydrogenated Lecithin	Heliofeel 22 MB	Lucas Meyer	3,00%
	Cetyl Alcohol	-	-	1,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 4

1. Heat phase A and phase B to 75°C
2. Pour phase B into phase A and mix with and homogeniser for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 5

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,30%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	C14-22 Alcohols, C12-20 Alkyl Glucoside	Montanov L	Seppic	2,50%
	Cetyl Alcohol	-	-	1,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 5

1. Heat phase A and phase B to 75°C
2. Pour phase B into phase A and mix with and homogeniser for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 6

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Polyglyceryl-4 Stearate, Potassium Olivate	Oleamuls o/w	Socri	4,00%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,30%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Cetyl Alcohol	-	-	1,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture form emulsion 6

1. Heat phase A and phase B to 90°C
2. Pour phase B into phase A and mix with and homogeniser for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 7

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,30%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Cetearyl Olivate, Sorbitan Olivate	Olivem 1000	Hallstar	3,00%
	Cetyl Alcohol	-	-	1,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 7

1. Heat phase A and phase B to 80°C
2. Pour phase B into phase A and mix with and overhead stirrer at high shear for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 8

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,30%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Polyglyceryl-2 Stearate, Glyceryl Stearate, Stearic Acid	PolyAquol 2W	Innovacos	2,50%
	Cetyl Alcohol	-	-	1,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 8

1. Heat phase A and phase B to 75°C
2. Pour phase B into phase A and mix with and overhead stirrer at high shear for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

Emulsion 9

Phase	INCI	Trade name	Supplier	Amount
A	Aqua	Distilled water	-	Up to 100%
	Glycerin	-	-	3,00%
	Xanthan Gum	Keltrol CG-SFT	CP Kelco	0,30%
B	Caprylic/Capric Triglyceride	-	-	20,00%
	Polyglyceryl-3 Dicitrate/Stearate	Tego Care PCS 3	Evonik	3,00%
	Cetyl Alcohol	-	-	1,00%
C	Sodium Benzoate, Potassium Sorbate	Euxyl K712	Schülke & Mayr	1,00%
	Citric Acid	-	-	To pH c.5

Method of manufacture for emulsion 9

1. Heat phase A and phase B to 75°C
2. Pour phase B into phase A and mix with and homogeniser for 10 minutes.
3. Stir while cooling down and add phase C once below 40°C.

METHODS

Sensory approaches were applied for characterization of the samples. The sensory assessors were Masters of Beauty and Cosmetics students at Laurea University of Applied Sciences, and they were given benchmarks against which to compare the emulsions' sensory properties.

Thirty-two students completed a questionnaire consisting of five sensory properties (absorption, play-time, spreadability, soaping and after-feel). Each parameter was rated on a scale 5 to 1, comparing to pre-decided benchmark products. In the scale, the five parameters were fast absorption, short play-time, good spreadability, no soaping, and pleasant after-feel. Each parameter has two benchmarks, documented in Table 1 one for each end of the scale.

Table 1 – sensory parameter benchmarks

Parameter	Description	Corresponds with 5 on the scale	Description	Corresponds with 1 on the scale
Absorption	Fast absorption	Lumene Moisturizing Day cream	Slow absorption	Tummeli cream (red)
Play-time	Short play-time	LV Balancing gel cream	Long play-time	Tummeli cream (red)
Soaping	Almost no soaping	Canoderm Effective moisturizing base cream	Lots of soaping	Aqualan L Emollient cream
Spreadability	Easy to spread	Mossa vitamin coctail 5in1 rehydration energising daycream	Hard to spread	Nivea Creme
After-feel	Pleasant after-feel	Aisti, lotion (unperfurmed)	Not pleasant after-feel	Apobase 60% oily cream

Each student was given the same training and instruction to do the sensory assessments, which were done on the inside of the forearm. Samples were applied one at a time to clean skin with clean hands, one arm for one product and benchmark products. On the first day of the evaluation, emulsions 1 and 2 were tested against benchmark products. Each parameter was instructed to study separately, for example absorption: apply the sample and both benchmark products, evaluate the sample on a scale 1 to 5. The sample grade was instructed to fill into the questionary immediately. Then next parameter was studied in the same way and finally sample 2 into another arm.

In the next day were studied emulsions 3 and 4, then emulsions 5 and 6 etc. Different days were instructed to use due to the large number of samples and benchmarks.

RESULTS

Data processing of sensory measurements is presented in Table 2. The subjectivity could have certain influence on the results.

Table 2 – results of the sensory analysis

#	Trade name	INCI	absorption	play-time	soaping	spreadability	after-feel
1	BergaMuls SL Sun	Lecithin	4,0	4,0	4,5	4,5	4,2
2	Dermofeel Easymuls Plus	Glyceryl Oleate Citrate	4,2	4,2	4,6	4,4	4,3
3	Emulfree CBG	Isostearyl Alcohol, Butylene Glycol Cocoate, Ethylcellulose	4,2	4,0	4,7	4,8	4,3
4	Heliofeel 22 MB	Glyceryl Stearate Citrate, Polyglyceryl-3 Stearate, Hydrogenated Lecithin	3,9	3,7	4,1	4,3	3,8
5	Montanov L	C14-22 Alcohols, C12-20 Alkyl Glucoside	3,2	2,8	3,3	4,1	3,8
6	Oleamuls o/w	Polyglyceryl-4 Stearate, Potassium Olivate	3,3	3,2	3,5	4,1	3,8
7	Olivem 1000	Cetearyl Olivate, Sorbitan Olivate	3,1	3,0	3,2	3,9	3,4
8	PolyAquol 2W	Polyglyceryl-2 Stearate, Glyceryl Stearate, Stearic Acid	3,0	2,8	2,9	3,9	3,2
9	Tego Care PCS 3	Polyglyceryl-3 Dicitrate/Stearate	3,8	3,6	3,6	4,3	3,7

Absorption

Here the analysis was focused on how well the emulsion absorbs or sinks into the skin. The results indicate that the emulsions with the best ease of absorption were emulsions 2 (Glyceryl Oleate Citrate) and emulsion 3 (Isostearyl Alcohol, Butylene Glycol Cocoate, Ethylcellulose) and the one that had the lowest ease of absorption was emulsion 8 (Polyglyceryl-2 Stearate, Glyceryl Stearate, Stearic Acid).

Play-time

Here the sensory analysers looked at how long on had to massage the emulsion into the skin before it felt sufficiently absorbed. The emulsions with the shortest playtimes was emulsion 2 and the emulsion with the longest playtimes were emulsion 5 (C14-22 Alcohols, C12-20 Alkyl Glucoside) and emulsion 8.

Soaping

Here the focus was on soaping, meaning how much whiteness and possible foam is present on the skin when the emulsion is being applied. The emulsion that exhibited the least amount of soaping was emulsion 3, while the one with the most soaping was emulsion 8.

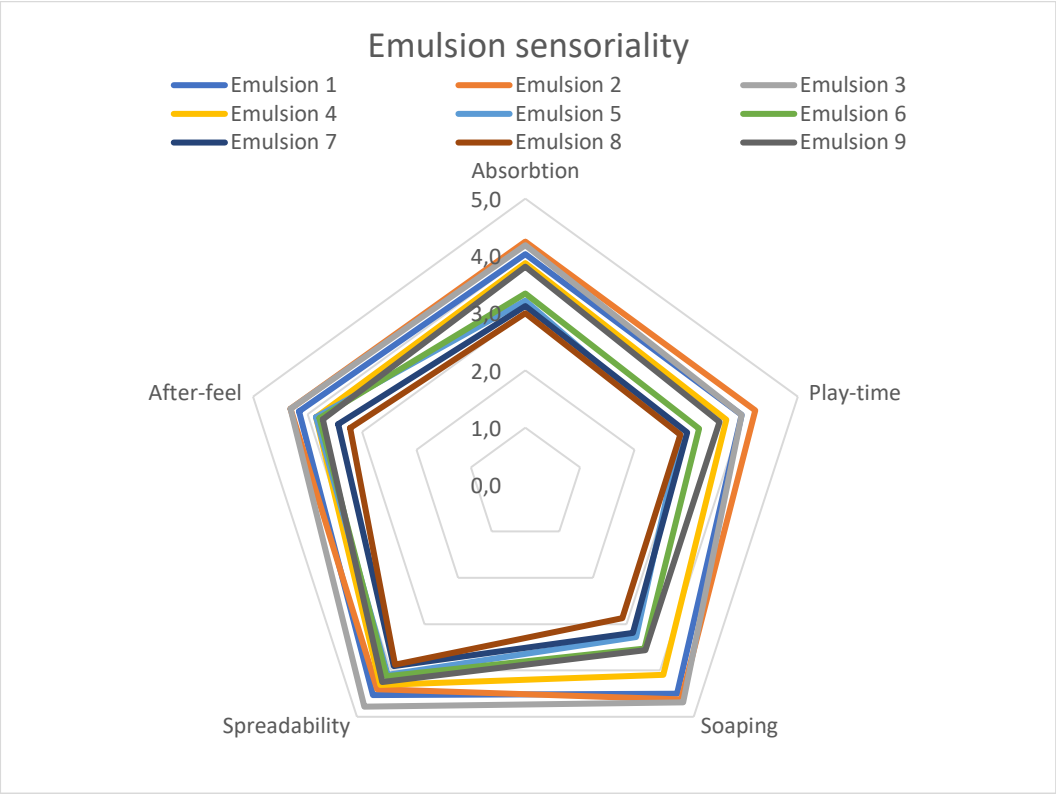
Spreadability

When looking at the spreadability, the sensory panel assessed how easy the product is to spread evenly on the skin with ease. The emulsion with the greatest spreadability was emulsion 3, while the lowest spreadability was exhibited by emulsion 7 (Cetearyl Olivate, Sorbitan Olivate) and emulsion 8.

After-feel

Here the analysis was focused on how the skin feels after using the emulsion. The lightest after-feel was achieved by emulsions 2 and 3 the most lasting after-feel was felt with emulsion 8.

Graph 1 – spider diagram of emulsion sensoriality



DISCUSSION

When it comes to light skinfeel and ease of spreadability, the classic natural cosmetics emulsifier 7 was outperformed in all aspects by emulsifiers 2 and 3. If a heavier and richer skinfeel is preferred, then emulsifier 8 would be the ideal choice.

The more middling emulsifiers were 4, 6 and 9, as they performed in all assessed categories at neither extreme end of the spectrum.

The study was carried out in collaboration with a group of Master of Beauty and Cosmetics students from Laurea University of Applied Sciences. Students prepared the products according to the formulations developed previously and carried out a sensory evaluation. There were nine emulsions and five different sensory properties evaluated to be evaluated. There were also several benchmark products to which the products were compared. Each sensory property was compared against two pre-defined benchmark products. In the end, there was so many products to be evaluated that not all could be evaluated at the same time.

In the future, it would be a good idea to simplify the system of self-assessment. For example, the same controls could be used to evaluate multiple properties.

The desired properties were well highlighted with this procedure. The diagrams constructed are informative. The tool created by this study can be used as a guide when selecting an emulsifier fit for purpose. The tool itself, can be used to describe different properties by changing the products and the emulsifiers.

In general, none of the emulsion performed at extreme ends of any of the aspects analysed. There is still development to be undertaken, if an extremely light skin-feel and extremely fast absorption is required. This could possibly be achieved by using the better performing emulsifiers, and combining them with the latest developments in volatile alkenes as the main emollients.

CONCLUSION

Natural cosmetics are no longer constrained by a limited choice of emulsifiers. With the new developments in the field of emulsifiers, light and fluid textures can be obtained, as well as more traditional rich textures. This gives formulators a larger scope to play around with texture, and skin-feel can be tailored according to different product specifications.

ACKNOWLEDGMENTS

The study was carried out in collaboration with a group of Master of Beauty and Cosmetics students from Laurea University of Applied Sciences.

CONFLICT OF INTEREST STATEMENT

None.

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