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Complexity in material interactionand their role in the functional kinematics of shampoo

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ABSTRACT: The present study deals about the material interaction in a shampoo system and its role in the end performance intended through the product. The viscosity booster has not altered either the flow property of the shampoo or the functional parameters such as foam height and foam retention. Considering the SLES and viscosity booster to be the main backbone of the formulation, least material interaction between them enables the better delivery of the key active molecules and their functions. Details are presented in the paper.

KEYWORDS: Shampoo, SLES, Viscosity booster,

I. INTRODUCTION

Shampoo is a toiletry preparation used vastly for maintaining the 'health' of hair and scalp and also it is also used for the purpose of cleansing. The formulation architecture of any shampoo contains primary and secondary surfactants with anionic or cationic charges. Besides the above, 'immiscible' and or relatively heavy and or slowly dissolvable constituents are also incorporated in the formulation for conditioning and or leveling the hair, post -wash. [1, 2, 3]

The shampoo system is also used for delivering the anti-dandruff agents, hair growth promoters and hair colorants wherever such customer requirements are high. The delivery of the active constituents in the formulation is largely influenced by 'the body' of shampoo which is otherwise called as the backbone architecture of the formulation.[4, 5, 6]

Knowing the basic material interaction between different chemical constituents of the shampoo is essential to understand the kinematics of different ingredients in the total formulation. Only with such knowledge the end benefit from the shampoo can be skewed and engineered. The most important material interaction would be the physical flow and viscosity besides the miscibility quotient of each constituent in the given formulation.

In the present study we have analyzed the material kinematics of different chemical constituents of a shampoo individually and collectively in the formulation and accordingly a formulation blueprint was worked out and the details are presented in the paper.

II. MATERIALS AND METHODS

Measurement of flow time of different ingredients in the formulation

We have studied a proprietary formulation and which is largely composed of SLES, GHTC gum and other co-actives; where the dosages of different actives are proprietary in nature.

The material flow time of SLES, SLES with 0.3%Guar HydroxypropylTrimoniumChloride(GHTC) and the finished formulation was checked by using a burette. In brief the time taken for dispensing every 1ml of the material from the burette from the total volume of 50ml was measured vis-à-vis time and such differences in the flow time between different materials was calculated and the statistical significance was done by studentt test.

Determination of foam height and foam retention

SLES, SLES with 0.3% GHTC and the finished formulation were subjected to foam height and foam retention time using the standard procedure.[7, 8]

III. RESULTS

Flow time of SLES with 0.3% GHTC and 0.3% GHTC in water

The difference in the flow time of SLES with 0.3% GHTC and 0.3% GHTC in water was not statistically significant and the statistical test details are given below

Paired t test results 0.3% gum in SLES and 0.3 % Gum

P value and statistical significance:

The two-tailed P value equals 0.5990

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By conventional criteria; this difference is considered to be not statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -0.0360

95% confidence interval of this difference: From -0.1854 to 0.1134

Intermediate values used in calculations:

t = 0.5450

df = 9

Standard error of difference = 0.066

Group	Group One	Group Two
Mean	0.2040	0.2400
SD	0.1011	0.2953
SEM	0.0320	0.0934
N	10	10

Flow time of 50% SLES & Shampoo

As expected the difference in the flow time of 50% SLES and shampoo was statistically significant and statistical details are given below

Paired t test results 50% SLES & Shampoo

P value and statistical significance:

The two-tailed P value equals 0.0011

By conventional criteria; this difference is considered to be very statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -3.6180

95% confidence interval of this difference: From -5.3489 to -1.8871

Intermediate values used in calculations:

t = 4.7284

df = 9

Standard error of difference = 0.765

Group	Group One	Group Two
Mean	0.0550	3.6730
SD	0.0165	2.4355
SEM	0.0052	0.7702
N	10	10

Flow time of 0.3% GHTC Gum in SLES and shampoo

As expected the difference in the flow time of 0.3% Gum in SLES and shampoo was statistically significant and statistical details are given below

Paired t test results 0.3% Gum in SLES and shampoo

P value and statistical significance:

The two-tailed P value equals 0.0011

By conventional criteria, this difference is considered to be very statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -3.4690

95% confidence interval of this difference: From -5.1392 to -1.7988

Intermediate values used in calculations:

t = 4.6984

df = 9

Standard error of difference = 0.7

Group	Group One	Group Two
Mean	0.2040	3.6730
SD	0.1011	2.4355
SEM	0.0320	0.7702
N	10	10

Flow time of 0.3% GHTC Gum in water and shampoo

As expected the difference in the flow time of 0.3% GHTC in water and shampoo was statistically significant and statistical details are given below

Paired t test results 0.3% gum and shampoo

P value and statistical significance:

The two-tailed P value equals 0.0007

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By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:
The mean of Group One minus Group Two equals -3.4330

95% confidence interval of this difference: From -4.9880 to -1.8780

Intermediate values used in calculations:
t = 4.9942
df = 9
Standard error of difference = 0.68

Group	Group One	Group Two
Mean	0.2400	3.6730
SD	0.2953	2.4355
SEM	0.0934	0.7702
N	10	10

Determination of foam height and foam retention
100ml of 1% shampoo was when shaken for 5 minutes,produced foam of 350ml height. 50% SLES with 0.3% GHTC produced foam of 470 and 460ml respectively for 100ml. Table - 1
The 350ml of the foam reduced by 30% in 30minutes in the case of shampoo and which further reduced to 50 and 80% respectively over 60 & 90 minutes.
The foam retention time in the case of SLES and SLES with 0.3% GHTC remain almost the same over 30, 60 and 90 minutes. Table- 1

Test details	Foam height (ml)	Foam retention time in minutes		
		30	60	90
Shampoo	100/350	30%R/350	50%R/350	80%R 350
50% SLES	100/470	60%R/470	90%R/470	100%R/470
50% SLES with 0.3% GHTC	100/460	59%R/460	88%R/460	98%R/460

IV. DISCUSSION

In the present study we have established that the material interaction between 0.3% of GHTC gum and SLES was found to be the least and that supports the fact that the viscosity boosters while boosting the viscosity should not alter the surfactant property of the shampoo base as well.

With reference to flow time between SLES and SLES with 0.3% GHTC, both remains statistically insignificant and so were the other key properties such as foam height and foam retention time. However the finished shampoo formulation showed distinct property with reference to flow time, foam height and foam retention from the individual materials used in the formulation. The above changes in the final formulation is necessary because the final formulation is made ought to give superior conditioning and active delivery for certain therapeutic benefits.

One of the elemental property needs to be preserved is the native characteristics of the base ingredients and the ingredient that is used to increase the viscosity.

The flow time is extremely important for the toiletry preparation because of the short contact time of such formulations. Only when a reasonable contact time with the scalp and hair can be achieved by the formulation the functional benefits intended through such formulation is possible.

The increase in contact time should be achieved through the addition of actives and not by the agent that is used for improving the viscosity. It means the viscosity should only inversely influence the material binding property of the actives over hair and scalp.

In the present formulation we have used the botanical actives to achieve anti-dandruff benefit, hair growth and hair conditioning. Since the botanicals are complex heavy particles, viscosity of the shampoo is the critical factor to maintain uniform and spatial distribution of the botanicals. However the viscosity should not interfere or compete with the botanicals.

We have limited our present observation to the primary surfactant where the primary surfactant forms the dominant body of the formulation and the secondary surfactants be it

amphoteric or anionic/cationic shall form only a small proportion of the formulation.

The foam retention and foam height as observed in the case of shampoo and so shall the statistically significant differences of the shampoo enables us to explain such differences were due to the botanicals, conditioning agents and secondary surfactant.

Although thorough material interaction and associated complexity between each and every ingredient, the relative proportion and time is necessary but such details are quite arduous to establish due to variety of variables such as phase of incorporation, temperature, pH, stirring force, the volume of foam generated during manufacturing etc.

Further the material interaction may tends to increase over time complying fully to the laws of thermodynamics which is otherwise called as increased entropy over time. Therefore the material interaction and the associated complexity may vary from initial point over time and therefore the key consideration should be the predominant ingredient(s) that gives the identity, characteristic distinctivity and organoleptic value for the formulation.

The present study is the first of its kind to establish the importance of the material kinematics and formulation science.

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