Poster ID #

SENSORY PANEL TESTS FOR TOPICAL SEMI-SOLID GELS: ROLE OF CRITICAL QUALITY ATTRIBUTES IN PREDICTING SENSORIAL PERCEPTIONS

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PURPOSE

Sensorial perception of topical pharmaceutical product on skin is the initial interaction of the patients/consumers with the product. A dislike to sensory perceptions can be a barrier for use. For example, if a product is "difficult to spread" or "too sticky", it undermines compliance. Therefore, it is valuable to explore and understand how formulation composition impacts sensory feelings. Human sensorial panel tests, like any human subject study, can be expensive. Both the difficulty in training human subjects and the subjective nature of outcomes are challenges for conducting a sensory panel test for topical drug products. Hence, the purpose of this work was to develop objective instrumental tests, that, when validated against the relevant sensory attribute, can provide an understanding of sensory perceptions. Here we assessed rheological, textural, and tribological properties of topical products, in vitro and evaluated six different sensory attributes in a sensory panel test, in vivo. To perform this work, we selected 8 gels with ~~two~~ 2 blinded replicates, having different concentration of hydroxyethyl cellulose (HEC) and carbomer homopolymer (Carbopol® 980P (CBP)) from 26 gel formulations (Table 1) by using statistical analysis, and compared the outcomes from sensorial panel test with instrumental analysis.

METHODS

Rheological experiments were performed on AR-G2 rheometer using steady-state controlled shear stress sweep test at 32ºC and 500 µm gap using 40 mm parallel plate. Texture profile analysis was performed to evaluate gel textural properties by a compression test using the TA.XTplus texture analyzer with a cylindrical probe of 38.1 mm diameter. Frictional property of gels was determined via tribology using a HR1 Discovery Tribometer, TA Instruments with three-ball on plate geometry. For in vivo sensory panel test, skin properties of a 46 interested and eligible subjects (males and females, aged between 19-30 years) with no skin conditions or regular/seasonal skin allergies, were firstly examined using a Courage + Khazaka (C+K) electronic GmbH instrument equipped with multiple probes to evaluate skin biophysical properties (n=46, ethics ID number: 2020/HE001995). Then, subjects were trained on the concepts and assessment criteria of six different sensory attributes in the sensory test, including spreadability, cooling sensation, shine, slipperiness, stickiness, and smoothness, classified as during, and after-feel sensations. To start the panel test, 0.25 µL of each gel sample was placed onto a marked forearm area (19.6 cm^2) of subject and spread by subject's forefinger at rotational speed of 1 circle/second, controlled by the metronome, for 15 seconds. After 15 seconds, subjects stopped spreading, and assessed cooling sensation, shine, and slipperiness. The after-feel attributes of stickiness and smoothness were evaluated after waiting for 1 and 2 minutes, respectively. Gel sensorial attributes were evaluated on a continuous 1-9 scale representing from very low (1) to very high (9) intensity.

Table 1. (a) *Formulations of hydroxyethyl cellulose (HEC) and (**b**) carbomer homopolymer (Carbopol® 980P (CBP)) gels in %w/w of compositions. Eight gels including HEC-02, HEC-07, HEC-08, HEC-10, and CBP-01, CBP-02, CBP-10, CBP-11 (in red) were selected out of 26 formulations for the sensory panel study.*

Composition (%w/w)	HEC-01	HEC-02	HEC-03	HEC-04	HEC-05	HEC-06	HEC-07	HEC-08	HEC-09	HEC-10	HEC-11	HEC-12
Hydroxyethyl cellulose	1	2.2	3	5	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Ethanol	20	20	20	20	25	30	45	50	20	20	20	20
Propylene glycol	15	15	15	15	15	15	15	15	20	30	40	50
2-Phenoxyethanol	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Water	63.2	62.0	61.2	59.2	57.0	52.0	37.0	32.0	57.0	47.0	37.0	27.0

Composition (%w/w)	CBP-01	CBP-02	CBP-03	CBP-04	CBP-05	CBP-06	CBP-07	CBP-08	CBP-09	CBP-10	CBP-11	CBP-12	CBP-13	CBP-14
Carbopol 980	0.5	0.25	0.65	0.25	0.25	0.5	0.5	0.5	0.1	1.0	0.5	0.5	0.5	0.5
Ethanol	-	-	-	-	-	-	20	-	-	-	35	50	10	-
Propylene glycol	15	15	15	25	35	35	15	50	15	15	15	15	15	25
Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Propyl paraben	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Triethanolamine	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.
Water	84.4	84.6	84.2	74.6	64.6	64.4	64.4	49.4	84.7	82.5	49.2	34.4	74.3	74.2

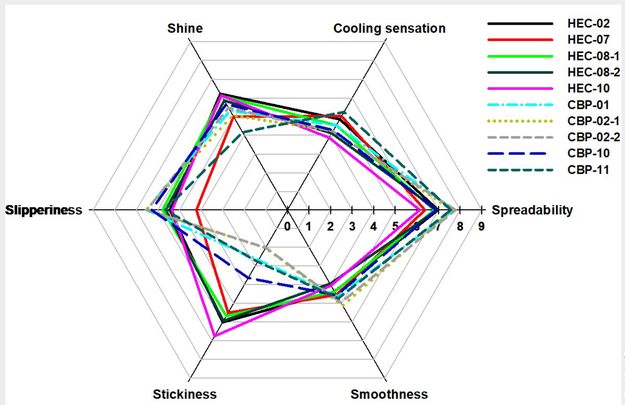

Figure 1. *Spider diagram of sensory scores of spreadability, cooling sensation, shine, slipperiness, stickiness, and smoothness attributes using 9-point hedonic scale of examined hydroxyethyl cellulose (HEC) and carbomer homopolymer (Carbopol® 980P (CBP)) gels including HEC-02, HEC-07, HEC-08, HEC-10, CBP-01, CBP-02, CBP-10, CBP-11 (codes and formulations shown in Table 1). HEC-08 and CBP-02 were two blinded replicates named as HEC-08-1, HEC-08-2 and CBP-02-1, CBP-02-2*

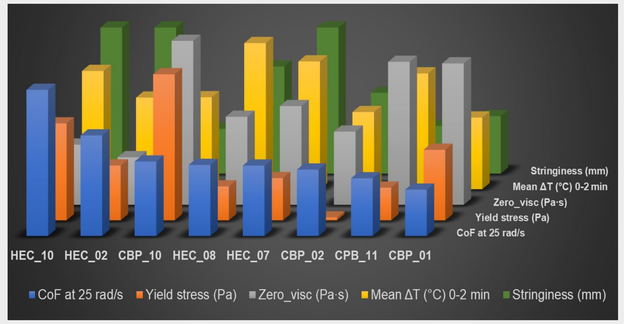

Figure 2. *Selected physicochemical and structural (Q3) properties (normalized for different units), including coefficient of friction (CoF) (tribology), zero shear viscosity (Zero visc), yield stress (rheological properties), mean temperature different from 0 to 2 min (Mean ΔT (ºC) 0-2 min), stringiness (texture properties) of eight examined topical gels having different concentration of hydroxyethyl cellulose (HEC) and carbomer homopolymer (Carbopol® 980P (CBP)), coded as HEC-02, HEC-07, HEC-08, HEC-10, CBP-01, CBP-02, CBP-10, and CBP-11 (codes and formulations shown in Table 1). The topical gels were selected from 26 gel formulations (Table 1) by using statistical techniques to summarize gel characteristics according to their Q3 properties.*

RESULT(S)

The measured skin biophysical parameters (C+K instrument) from the 46 subjects exhibited high interindividual variability, indicating a true sample from the general population. Intensity scores of attributes for the examined topical gels are represented in Figure 1. Although subjects had huge differences in skin biophysical properties, they perceived sensorial attributes of the two sets of blinded replicates, consistently. Among the sensory attributes that were evaluated, differences in spreadability, slipperiness, and stickiness of the gels were well perceived by the subjects. However, cooling sensation, shine, and smoothness were perceived with only slight differences among tested products. Coefficient of friction (CoF) measured in vitro is valuable in understanding spreadability, as HEC gels, with higher CoF values, ranked lower in intensity of spreadability compared to CBP samples, except for the CBP-10 (Figure 2). The CBP-10 gel had a higher polymer amount at 1% w/w and highest measured yield stress of 208.8 Pa among gels (Figure 2). Carbomers are well-known excipients contributing to the product texture. Crosslinked carbomer chains resulting in closely packed individual microgel particles provide the integrity and strength of the gel structure. However, at a high concentration, yield stress, a function of the amount of work required to spread the product, might cause a cohesive resistance during skin application, and lead to a reduction in spreadability of the CBP-10 gel. Perception scores of slipperiness of HEC gels were found to be lower than those of CBP gels overall (Figure 1). With the higher ethanol concentration, HEC gels evaporate faster, and leave a dried solid film on the applied skin area leading to reduced slipperiness. On the other hand, HEC gels were perceived stickier than CBP gels. This could be explained by higher friction (tribology) and stringiness (textural properties) of the HEC gels compared to CBP gels, as shown in Figure 2.

CONCLUSIONS

We demonstrate that most of the sensorial attributes of gel formulations can be correlated to their physicochemical and structural properties assessed in vitro. Significant differences in quality attributes, such as rheological, tribological behaviour, and texture properties, assessed instrumentally in vitro are likely to be perceptible to human subjects. Quality attributes such as rheological, tribological behaviour, and texture profile of topical formulations demonstrate a promising means of understanding sensorial perceptions.

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