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How a combination of innovative methods can help for the development of new deodorant Products

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Introduction

Sweating is an essential process to maintain the human body at an optimal temperature. Nevertheless, it may induce two major inconveniences: wet sensation and malodor. This is why we developed a screening test strategy for the selection of deodorant ingredients. This methodology is oriented through the evaluation of humidity sorption by powders and malodor covering with fragrances. Humidity sorption and desorption studies were conducted on several powders by gravimetry, quantifying the maximal amount of synthetic sweat absorbed by powder.
We characterized with Environmental Scanning Electron Microscopy (ESEM) the behavior of selected powders under humidity by increasing and decreasing pressure. Sweat sampling from volunteers was analyzed using an electronic nose technology. Comparison of sweat signals treated or not with fragrances allowed us to discriminate their efficacy by their ability to mask odor. Self-assessment of a deodorant with different fragrances was proposed to volunteers for appreciation.

Materials & Methods:

Biological mechanisms Action

Screening tests methodology

Sweat Gland secretion

Block secretion of glands

Not studied, it refers to an antiperspirant action

Sweat absorption and retention by powders

SWEAT ABSORPTION ANALYSIS

6 natural powders (A to F)
Ability to absorb sweat/humidity and rate of desorption

1.1 Powder absorption ability
Method inspired form ISO 787-5:1980, part 5
Synthetic sweat (ISO 105-E04:2008, part 4)

1.2 Powder desorption rate
Sweat loss by Gravimetry

1.3 Behavior of powders towards humidity in environmental microscopy : Dynamic observation
Observation of shape and behavior of powder under humidity by increasing pressure.
Apparition of state of water condensation in the SEM chamber
•Observation of powder under decreasing pressure

Sweat presence

Bad odor coverage - Fragrance

ELECTRONIC NOSE STUDY

Biochemical nano sensor able to link to odorant volatile compounds
3 fragrances compared : A,B,C
Sweat sampling on 5 volunteers : age: 25-55

Bad odors generation

2.1 Characterization of sweat: interindividual variability and similarities
Normalized radar chart representing 64 sensors
Intensity reflects the level of VOC linked to the sensors

2.2 Observation of sweat profile evolution in time (example of volunteer 1)

2.3 Modification of sweat signal with different fragrances – malodor coverage

SELF ASSESSMENT TEST

n=10
Age 22-50
5 fragrances compared : A to E

One day per deodorant (with randomization) in real life condition

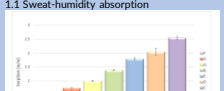
Appreciation questionnaire including efficacy, evocation of freshness, fragrance appraisal

FRAGRANCE SELECTION

Results & Discussion:

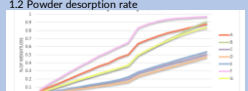
1. Powder ability to Sweat/humidity absorption and retention

1.1 Sweat-humidity absorption



Graph 1: Classification of the level of sweat absorption, in g of powder/g of sweat

1.2 Powder desorption rate



Graph 2: Rate of desorption, % of weight loss

Powder C absorbed progressively a high level of sweat, until a state of saturation. Powder F is rapidly saturated and doesn't seem to swell.

Gravimetric measurement shows the higher rate of desorption for powder F, with a 50% loss of sweat absorbed at 105 min. Powders C, D, F present the lowest desorption rate. After 7 hours, they lose less than 50% of sweat.

1. 3 Dynamic humidity absorption observation via ESEM

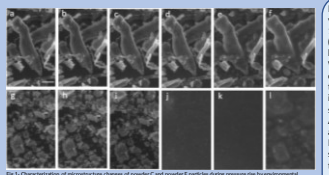
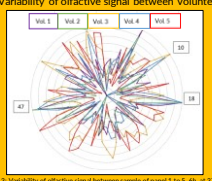


Fig 1: Characterization of microstructure changes of powder C and powder F particles during pressure rise by environmental scanning electron microscopy, at 500x magnification. a to f powder C, g to j powder F. a & g 5,4 Torr - b & h 5,45 Torr - c & i 5,5 Torr – d & j 5,55 Torr – e & k 5,6 Torr – f & l 5,65 Torr. Scale bar 20µm

Powder C appears composed of fibers with various size length. Fibers do not exceed 100µm. During the rise in pressure (hydration) the fibers get bigger, this swelling kinetics is observed from 5.40 to 5.65 Torr. Water droplets appear at 5,65 Torr. During drying, water disappears and the volume of the fibers decreases. The shape of the fibers is very similar to its initial dry state.(not shown)
At the same magnification Powder F size appears smaller and has a spherical shape. During the hydration sequence, water spreads quickly (5.55 Torr) before covering the field of observation. After drying, we observed aggregation of particles more compact than initially.

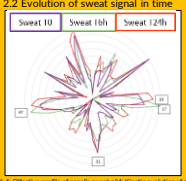
2. Bad odor coverage using electronic nose technology

2.1 Variability of olfactive signal between volunteers



Graph 3: Variability of olfactive signal between sample of panel 1 to 5, 6h, at 37°C

2.2 Evolution of sweat signal in time

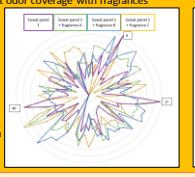


Graph 4: Olfactive profile of panel's sweat n°4; Kinetic evolution of sweat signal

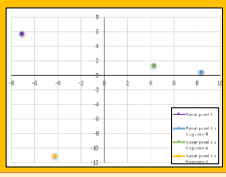
After 6 hours at 37°C, we observed for each volunteer a specific profile showing a variability inter individuals in term of sweat composition (exited sensor).
Some peaks were present in all the profiles (10,18,47).

To follow the evolution of sweat in time, we focused on volunteer 4 by comparing data at T0,T6h,T24h. Volatiles compounds are linked particularly to sensors 10, 15, 17, 31, 46, 47, 53, 61 at T0. Kinetics measurements showed a growing intensity appearing at T6h and more intensely at T24h on sensors 16,17,31 and 47.

2.3 Sweat odor coverage with fragrances



Graph 5: Olfactive signal of sweat after 6h at 37°C, with and without deodorant with fragrance A,B,C, volunteer 1.



Graph 6: PCA for volunteer 1, spatial representation of untreated and treated sweat with fragrance A,B,C

Focusing on volunteer 1, radar of sweat shows the most important signal measured on sensors 6, 17, 46. A new profile is generated when sweat is mixed with different fragrances. New sensors are solicited. To evaluate the fragrance with the most efficacy in its capacity of masking odor, we represented on Principal Component Analysis (PCA) the untreated sweat and sweat treated with fragrance.
Data were analyzed individually for each panelist. Observation was made to detect which fragrance appears more different than sweat signal (meaning far on PCA). We obtain most volunteers with higher distance between untreated and treated sweat for product with fragrance B (3/5) followed by fragrance C (2/5).

3. Self assessment test

Focusing on A,B,C fragrances, product C with better global notes than A and B presents a pleasant fragrance and freshness evocation for 80% of volunteers. Improvement should be the persistence of perfume in time. The results seems aligned with electronic nose study where the B fragrance appears more efficient. However, we noticed that the preferred formula was A, which reveals the importance of individual hedonic appreciation, despite the perceived efficacy.

Conclusions:

With this step-by-step approach we developed a screening strategy to help the selection of ingredients for efficient anti humidity and anti-odor deodorant. The properties of powders under humidity can be assessed with a simple gravimetric protocol. Observation at a microstructural level, thanks to real time monitoring ESEM allows a better understanding of interaction of these powders with water.

The second step was to compare fragrance efficacy in terms of odor covering. We chose to use a particular and still not very documented electronic nose technology. We clearly observed a variability between subjects, and a modification of the sweat signal in time, testifying of the presence of more volatile compounds, probably responsible for malodor. Finally, we were able to appreciate fragrance proposals in terms of covering effect by their ability to transform the signal of odorant sweat. This latter approach is very promising and needs more data to deepen the phenomenon of malodor generation and covering. The self-perception evaluation is essential to give us confirmation of the ingredients selected and warns us to consider the consumer preference.

References:

1 Sato, K., & Sato, F. (1987). Sweat secretion by human axillary apoeccrine sweat gland in vitro. The American Physiological Society, R181-R187
2 M. Kanlayavattanakul, N. Lourith (2011). Body malodors and their topical treatment agents. International Journal of Cosmetic Science, 33, 298-311
3 D. Taylor, A. Daulby, S. Grimshaw, G. James, J. Mercer, S. Vaziri (2003). Characterization of the microflora of the human axilla. International Journal of Cosmetic Science,25, 137-145

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