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Sensory Analysis of the Foot Deodorisation Efficiency of a Commercial Product

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The efficiency of a feet deodorization product was tested on a group of previously screened volunteers under laboratory conditions. Feet odour intensity was assessed by a calibrated and trained olfactory panel after 24 hours and 48 hours of continuously wearing the same socks. The results demonstrated that the tested deodorization product was effective in reducing the feet odour intensity from distinguishable to weak. Such reduction was equivalent to the 23% and the 30% after 24 hours and 48 hours, respectively, in terms of odour intensity units.

1. Introduction

In an increasingly competitive global world, the sensorial characteristics of products and materials are crucial for their market acceptance. This is specially the case for odours, as smell has been cited as the most powerful and emotional of all the senses (Brynie, 2009). Crucial aspects in the odour perception of final products primarily arise from the presence of undesirable odours, and when selected aromas are not appealing enough for target consumers. This is fundamental in scent marketing, a trend in company branding of a variety of sectors, such as hospitality, retail, consumer packaged goods, beauty and healthcare, for creating a strong and lasting emotional connection with customers. In the particular case of products and materials with a deodorisation capability, efficiency assurance is vital to guarantee commercial success.
Sensorial analysis is a key methodology to reveal consumer perception in the previously described scenarios, thus allowing the optimisation of product performance, both in terms of perception and costs. A range of standard techniques allow the assessment of products and materials based on their odorous properties from a human sensory perspective, including odour concentration, odour intensity, hedonic tone and acceptance, polarity and aromatic profiles, in-use tests, customised bespoke tests, online surveys and text message voting, using trained or naïve sensory panels, etc. If required, advanced chemical analysis, such as high definition GC-MS, GC-IMS and GC-sniffing, can complement sensory results for elucidating the reasons behind perceptions (Vera et al. 2013).
This study presents the results of a sensory analysis to evaluate the efficiency of a commercial feet deodorant. The product deodorisation capability was assessed at two different times: 24 hours and 48 hours after application. A set of in-vivo tests was designed amongst a group of pre-selected volunteers in order to evaluate the effect of the product on foot sweat odour. A panel of sensory experts, previously selected and trained to distinguish the characteristics of the odour under study, participated on olfactory tests. Foot odour intensity was evaluated with no product application (baseline for odour generation) and statistically compared with tests on product application for determining the product deodorization efficiency.

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2. Materials and Methods

2.1 Selection of volunteers

A group of volunteers (39 individuals) were screened in relation to their feet sweat odour under laboratory conditions. As the deodorant product is unisex, candidates from both sexes were included. Ten days prior to the selection tests candidates had to wash their feet only with an unscented neutral gel according to the following protocol (Figure 1): each foot was soaped for 30 seconds with the neutral gel, thorough fully rinsed and dried. A pair of socks supplied by Odournet had to be wore continuously for 24 hours (including the sleep time). After 20 hours, a cotton pad had to be placed inside each sock, at the foot sole, covering from the tip of the fingers to approximately half of the sole. These pads were wore during 4 hours until completing the total 24 hours since the start of the assay.

Figure 1: Snapshots on the selection procedure of candidates for participating in the feet deodorant efficiency assay: Feet washing (A) and drying (B), glass jars (C), socks, pads, and other materials used in the assay.

The sensory evaluation was conducted by paired comparison of each individual's feet (right foot versus left foot) to determine if the smell was homogeneous and strong enough to perform the actual deodorization efficiency test. The considered parameter was odour intensity based on a predetermined scale ranging from 0 (not perceivable), 1 (very weak), 2 (weak), 3 (distinguishable), 4 (strong), and 5 (very strong). In order to be qualified, volunteers had to generate feet odour with an intensity of at least 2. Odour assessment was carried out by six panellists, previously calibrated in relation to their olfactory capacity according to the European Standard (EN13725, 2003) and trained to distinguish and rank body odours based on the United States Standard (ASTM E1207 – 09, 2009). The sensory panel of Odournet is continuously trained to be able to classify different types of odours (sweat, saliva, urine, fragrances, polymers, etc.) in terms of their intensity and olfactory notes. Their performance is regularly assessed to confirm whether their judgement fulfils certain statistical parameters.

3. Product deodorization efficiency test

The previously selected volunteers that qualified for generating sufficient feet odour (30 individuals) participated in the product deodorization efficiency test. During the days previous to the test, they were not allowed to use any type of feet deodorant, cosmetics, and care product, and were only allowed to wash their feet with an odour neutral gel. The product efficiency test was based on the following protocol (Figure 2):

- Day 1: Each volunteer washed their feet in the lab with a neutral soap, as previously described, and were supplied with cotton socks to be wore continuously for 48 hours. Cotton pads were also given for subsequent sample collection.
- Day 2: After 20 hours, a cotton pad had to be placed inside the sock, at the sole of each foot covering the fingers' tips, and had to be wore for 4 additional hours. The pads were then delivered to the lab and were confined in glass jars to be evaluated by a panel of six expert evaluators (sample T0_24, baseline after 24 hours, each individual's right and left feet were assessed).
- Day 3: After 44 hours a new cotton pad was placed inside each used sock, wore for 4 additional hours, and delivered back to the laboratory (sample T0_48 base line after 48 hours, each individual's right and left feet were assessed). Each of the volunteers washed both feet and the deodorant product was

applied according to the manufacturer instructions, but only to one random foot (the right foot in 50% of the volunteers and the left in the remaining 50%). New socks were provided to be wore during the subsequent 48 hours.

- Day 4: The procedure from day 2 was followed, so that each volunteer treatment and control feet were evaluated and compared after 24 hours of product application (sample T1_24, paired evaluation of control (01) and treatment (10) feet after 24 hours).
- Day 5: The procedure was similar from that of day 3, so that treatment and control feet in each volunteer were compared after 48 hours of product application (T1_48, paired evaluation of control (01) and treatment (10) feet after 48 hours).

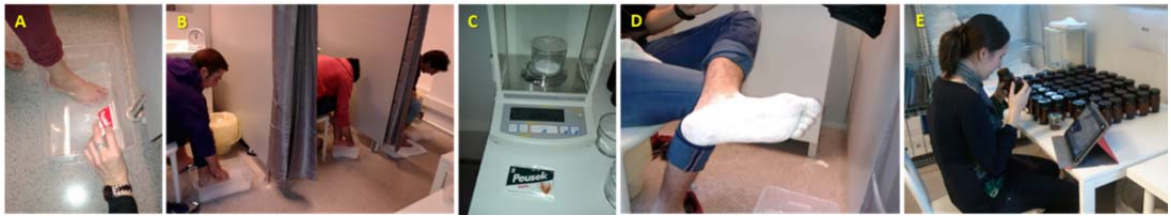


Figure 2: Snapshots from the efficiency test of a feet deodorant: product application (A–D) and subsequent olfactive evaluation by a panel of experts (E).

Odour intensity records reported by the olfactory panel were treated with the SPSS Statistics software. Descriptive statistical parameters of centralization (arithmetic mean, median, maximum and minimum values), dispersion (standard deviation, interquartile range (IQR)), coefficient of variation (CV), and Spearman's rank correlation coefficient between untreated and treated samples were obtained. Concerning the inductive statistical study, the rank Blom transformation on odour intensity records was used. Two-tailed hypothesis test with a significance level of 0.05 (p-value) was applied.

4. Results

From the 39 candidates that took part in the selection procedure in relation to their feet body odour, a total of 30 individuals were qualified and took part in the assay. The results of 26 volunteers were finally considered based on a feet odour intensity records higher than 2 (weak) after wearing the same socks for 24 hours in the baseline assay (Table 1). From those, the average baseline odour level (samples T0_24) was distinguishable (odour intensity 3) and no significant differences were observed from paired comparisons between the right and left volunteer's foot. Hence, odour generation can be considered as homogeneous in relation to body symmetry (right versus left foot). On the other hand, the difference between the untreated baseline (samples T0_24) and treated feet (samples T1_24) was significant, with an odour reduction from distinguishable to weak. In addition, differences between the paired individual's treated (10) and control foot (01) during the deodorant efficiency test (samples T1_24) were also significant and were equivalent to a reduction of the 23% in intensity scale units.

Odour intensity monitoring was repeated after 48 hours of continuously wearing the same socks (Table 2). As with the previous 24 hours measurement, the average odour intensity in baseline assays was perceivable and differences between individuals' paired right and left foot were not significant, confirming the homogeneity of odour emission in both feet from the same person. On the other hand, the foot that was treated with the deodorant consistently displayed lower odour intensity records, in the range of weak, in relation to both the previously characterized baseline and the corresponding untreated control foot. The average difference in odour intensity between treated (10) and control (01) foot corresponded to an odour reduction of 30% in the intensity scale, from perceivable to weak.

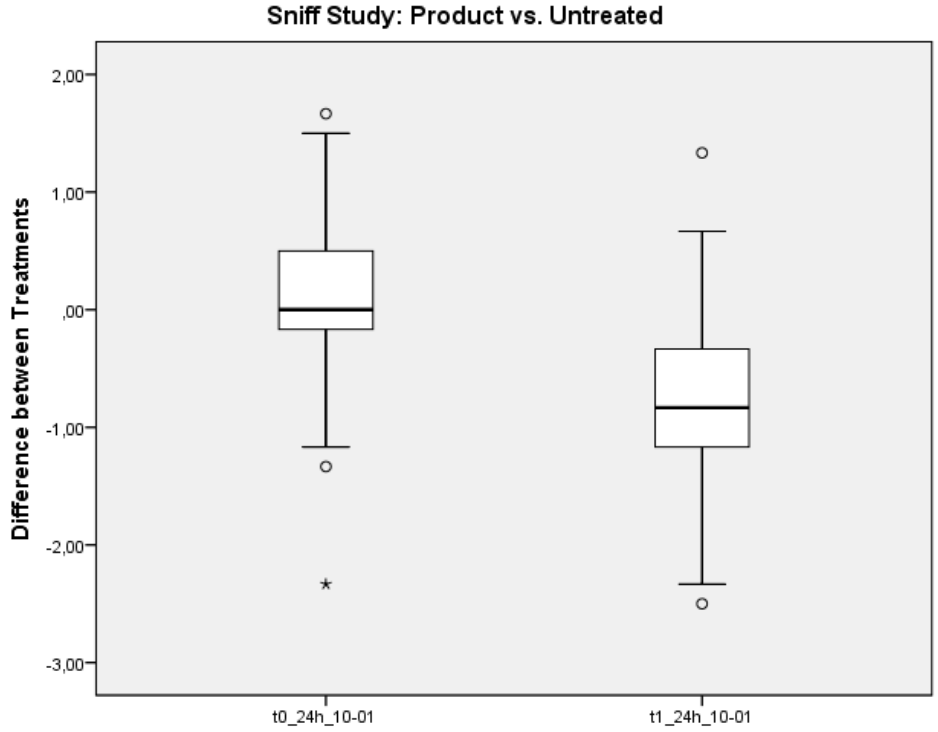
Table1: Comparisons between the average feet odour intensity in socks continuously wore for 24 and 48 hours in feet treated with a deodorant product (10) in relation to paired non-treated control feet (01), and in relation to a previous baseline assay without product application. Statistical significance has been set at p=0.05 (n=26).

Treatment	Foot code	Odour intensity				
		Baseline assay (T0)		Deodorant assay (T1)		
Odour evaluation after 24 hours						
Untreated foot (without deodorant)	01	3.14		2.90		
Treated foot (untreated in baseline assays)	10	3.16		2.22	⇩	⬇
Treatment (deodorant) – Control (without deodorant)	10-01	0.02		-0.68		
Odour evaluation after 48 hours						
Untreated foot (without deodorant)	01	2.98		3.19		
Treated foot (untreated in baseline assays)	10	3.15		2.23	⇩	⬇
Treated foot (deodorant) – Untreated foot (control)	10-01	0.17		-0.962		

⬇ : Intensity registers significantly lower than the results of the baseline assay (T0).

⇩ : Intensity registers significantly lower than the control untreated foot (01)

The previously reported statistical differences in odour intensity between paired feet (right versus left) in baseline (T0: no treatment) and deodorization assays (T1: treated foot versus untreated foot) have also been represented in a box plot (Figure 3). These results further illustrate the homogeneity of odour generation between each individual right and left feet in the baseline assay, and the reduction in odour intensity prompted by the application of the deodorant product.



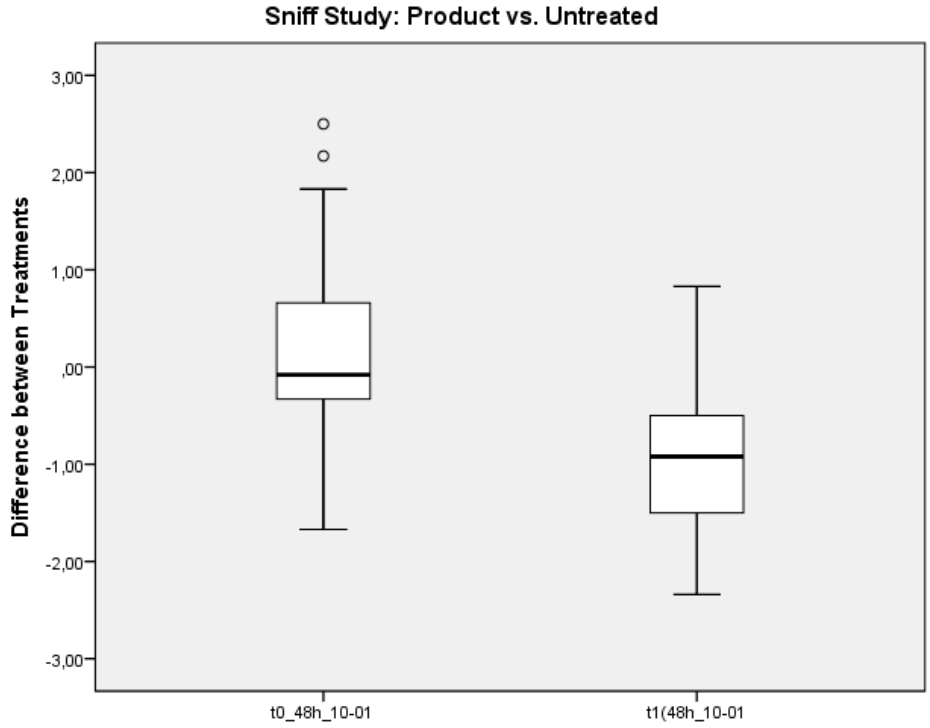


Figure 3: Box plot results on the odour intensity difference between right and left feet in the baseline assay (T0_24_10-01) and in the deodorization study (T1_24_10-01) after 24 hours (upper graph), and between right and left feet in the baseline assay (T0_48_10-01) and the deodorization study (T1_48_10-01) after 48 hours (lower graph).

5. Conclusions

From the previously reported results, the following conclusions regarding the effectiveness of a commercial feet deodorant after being applied in individuals (in vivo test) and tested in real usage conditions (in vivo test) has been withdrawn:

- The baseline assay for determining the reference odour intensity revealed that feet odour was ranked as distinguishable without deodorization treatment. No significant differences in odour intensity were reported after 24 hours and 48 hours.
- Differences on the feet odour intensity between right and left feet in the selected test individuals during baseline assays were not significant. Hence, odour generation was homogeneous at the individual level, being results comparable.
- Odour intensity records in the treated foot after 24 hours of the application of the deodorization product were significantly lower than that of the corresponding individual's untreated control foot ($p<0.05$). This reduction was reported from distinguishable to weak, and was equivalent to the 23% in odour intensity units.
- Odour intensity records in the treated foot after 48 hours of the application of the deodorization product were significantly lower than that of the corresponding individual's untreated control foot ($p<0.05$). This reduction was reported from distinguishable to weak, and was equivalent to the 30% in odour intensity units.
- In summary, the tested product was effective in reducing the feet odour intensity and its deodorization effect lasted for at least 48 hours.

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