SHORT REPORT

Sense of smell in workers exposed to agricultural odours

V. Gudziol1, D. Mackuth1, B. Hauswald1, J. Knothe1, K. Scheuch2, T. Zahnert1 and T. Hummel1

Aim
To investigate the effect of occupational exposure to agricultural odours on sense of smell.

Methods
Olfaction was investigated in 60 employees of dairy and pig-breeding farms and compared to 60 non-farm controls living in the same rural area. Both groups were matched for age, sex and smoking habits. All participants underwent standardized, validated tests for olfactory function and were tested before and after the first day of a working cycle. In addition, farm subjects were also tested in the evening of Day 5 of this period.

Results
There was no difference in overall olfactory function between the two groups. Olfactory function was not related to duration of exposure to the odorous environment.

Conclusion
These results suggest that occupational exposure to strong agricultural odours has no major impact on the sense of smell.

Key words
Environment; nose; odour; smell.

Introduction
Odours are an important part of our environment. Based on the concept of cross-adaptation it can be assumed that presence of certain odours would also influence the responsiveness to other odours [1,2]. In this context, however, it is unclear whether and if so, how such odorous environments impact on the olfactory sensitivity of individuals who are exposed to these environments. To our knowledge, there is only one publication [3] on effects of long-lasting exposure to manure odour; these authors observed no significant effect of this condition on an olfactory screening test. In another study, subjects working in perfume retail outlets did not demonstrate different test results of odour identification but better odour discrimination abilities than controls. Thus, the aim of the present study was to investigate whether people exposed to manure odours would exhibit different test results for odour identification, discrimination and for n-butanol odour thresholds compared to subjects without such exposure to odours.

Methods
We compared olfactory function of employees of dairy and pig-breeding farms to that of non-farm controls matched for age, sex and smoking habits who did not work in such odorous environments but lived in the same rural area. Olfactory tests were performed on farm workers in the morning and evening of a full working day (generally a 8-h working day). In addition, they were tested during the evening of the last day of a 5-day working cycle. The sequence of the three tests was randomized across all farm workers. Controls were tested only in the morning and evening of the first working day of a week. Testing was performed in the same area where subjects went to work in quiet, well-ventilated rooms.

Subjects were instructed to refrain from smoking, drinking anything but water and eating for an interval of at least 30 min before testing. Exclusion criteria were employment for <3 months, or severe diseases, e.g. multiple sclerosis. Prior to examination of olfactory sensitivity subjects were asked to fill in a questionnaire with questions related, for example, to general olfactory abilities.

For assessment of olfactory function pen-like odour dispensing devices (‘Sniffin’ Sticks’) were employed [4,5]. This validated kit consists of three tests of olfactory function, namely tests for n-butanol odour threshold, odour discrimination and odour identification.

Data were investigated using SPSS 12.0 for Windows®. Differences between farm workers and non-farm controls were compared using the Mann-Whitney U test. For comparison over time within the farm group the Wilcoxon matched-pairs signed-rank test was used. Results were considered to be significant at p<0.05.

1Smell and Taste Clinic, Department of Otorhinolaryngology, University of Dresden Medical School, Fetscherstr. 74, 01307 Dresden, Germany.

2Department of Environmental Medicine, University of Dresden Medical School, Fetscherstr. 74, 01307 Dresden, Germany.

Correspondence to: Thomas Hummel, Smell and Taste Clinic, Department of Otorhinolaryngology, University of Dresden Medical School, Fetscherstr. 74, 01307 Dresden, Germany. Tel: +49 351 458 4189; fax: +49 351 458 4326; e-mail: thummel@mail.zih.tu-dresden.de

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controls were analysed using repeated measures (rm)-
ANOVAs [analyses of variance, general linear model, re-
peated measures design, ‘test’ (threshold, discrimination,
identification) or ‘session’ (morning, evening) as within-
subject factors and ‘group’ (farm workers, controls) as
between-subject factors]. In the case where the main
effects of the factor group or its interaction with the factor
test were significant, post hoc comparisons between groups
were performed using t-tests. In addition, rm-ANOVAs
were used to investigate effects of the time of day/effects of
the day of week [within-subject factors tests (threshold,
discrimination, identification) or session (Day 1, morn-
ing; Day 1, evening; Day 5, evening)]. Finally, partial cor-
relations controlling for age were performed. Degrees of
freedom are indicated in brackets following F- or t-values.

The study was performed according to the Declaration
of Helsinki. It was approved by the Ethics Committee
of the Medical Faculty of the University of Dresden
Medical School. All subjects provided written informed
consent.

Results

We investigated 60 farm workers at six dairy and pig-
breeding farms [age range 23–58 years, mean age 41.8 ±
7.9 years (mean ± standard deviation); 39 women,
21 men; duration of employment in this environment
0–41 years, mean 18.2 ± 9.9 years]. There were 20 smok-
ers among the farm workers. Their test results were com-
pared to a group of 60 controls matched for age, sex
and smoking habits who lived in the same area as the farm
workers (age range 25–61 years, mean age 42.0 ± 7.8
years; 39 women, 21 men; duration of employment in this
environment had no major influence on general olfactory
abilities.

Comparisons between farm workers and controls did not
yield any significant differences for olfactory function
(Table 1; factor group: F[1,118] = 0.95, P = 0.33; factor
session: F[1,118] = 1.71, P = 0.19; session × group:
F[1,118] = 0.36, P = 0.55) indicating that the odorous
environment had no major influence on general olfactory
abilities.

In addition, there were no effects of the time of expo-
sure to environmental odours on olfactory function in
farm workers as indicated by the non-significant findings
for factors session (F[2,114] = 1.27, P = 0.28) and the
missing significance of the interaction session × test
(F[4,228] = 0.95, P = 0.43). Finally, in farm workers
there were no significant correlations between olfactory
tests and the number of years working in odorous en-
vironments (r < 0.08, P > 0.56).

Discussion

Our study found that the olfactory function of employees
do not differ from controls who lived in the same rural area. In addition, the
duration of exposure to strong environmental odours had
no major effect on general olfactory abilities.

The present results extend work by Snyder et al. [3].
Using an olfactory screening test they did not observe
significant changes between farmers and non-farmers in
terms of their abilities to identify odours. The present
study did not reveal differences between farm workers
and controls with respect to odour discrimination. In
fact, employees continuously exposed to odours in perf-
ume retail outlets exhibited an increased ability to dis-
criminate between odours [6]. This finding can now
better be explained by a training effect due to the con-
tinuous active engagement with a large variety of fragrances
(compare) [7,8] than with a continuous exposure to an
odorous environment.

For most smokers and some passive smokers tobacco
smoke is the most important environmental odour they
are exposed to. Berglund et al. [9] demonstrated a de-
creased olfactory sensitivity in smokers only for those
odours that are present in tobacco smoke. This specific
desensitisation to odours may also explain why farm
workers did not demonstrate decreased olfactory
function compared to controls. Thus, olfactory cross-
adaptation does not seem to be a major factor in these
occupational conditions.

Taken together, the present data obtained in a rela-
tively large sample of subjects using a sensitive and vali-
dated olfactory test battery indicate that environmental
exposure to strong odours has no major effect on general
olfactory function.

Table 1. Descriptive statistics of measures of olfactory function in
farm workers (n = 60) and controls (n = 60) [means, standards
errors of means (SEM)]

<table>
<thead>
<tr>
<th></th>
<th>Farm workers</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odour identification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>morning 1st day</td>
<td>13.2 ± 0.21</td>
<td>13.7 ± 0.22</td>
</tr>
<tr>
<td>Odour discrimination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>morning 1st day</td>
<td>11.9 ± 0.29</td>
<td>12.4 ± 0.31</td>
</tr>
<tr>
<td>Odour threshold 1st day</td>
<td>11.5 ± 0.52</td>
<td>11.7 ± 0.45</td>
</tr>
<tr>
<td>Odour identification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>evening 1st day</td>
<td>13.5 ± 0.20</td>
<td>13.7 ± 0.24</td>
</tr>
<tr>
<td>Odour discrimination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>evening 1st day</td>
<td>11.4 ± 0.32</td>
<td>12.1 ± 0.31</td>
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<tr>
<td>Odour threshold</td>
<td></td>
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</tr>
<tr>
<td>evening 1st day</td>
<td>11.5 ± 0.56</td>
<td>11.3 ± 0.55</td>
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<tr>
<td>Odour identification</td>
<td></td>
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<tr>
<td>evening 5th day</td>
<td>13.4 ± 0.21</td>
<td>–</td>
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<tr>
<td>Odour discrimination</td>
<td></td>
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<tr>
<td>evening 5th day</td>
<td>11.9 ± 0.29</td>
<td>–</td>
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<tr>
<td>Odour threshold</td>
<td></td>
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<tr>
<td>evening 5th day</td>
<td>11.6 ± 0.53</td>
<td>–</td>
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</tbody>
</table>

Measures were taken either in the morning or in the evening of a day of usually
8 h of work. In addition, in farm workers measures were also obtained at the
evening of the last day of a 5-day working cycle.

–, not analysed.
Acknowledgement

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Conflicts of interest

None declared

References