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ProfiSens – A PROFILE ANALYSIS SUPPORTING SOFTWARE IN FOOD INDUSTRY, RELATED RESEARCH AND EDUCATION

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Abstract

The Sensory Laboratory of Postharvest Department (Budapest University of Economic Sciences and Public Administration, BUESPA) has a specially designed sensory booth system which was established in accordance with the relevant ISO standards [2]. The researchers of the Sensory Laboratory (BUESPA) and of the Department of Chemical Information Technology (Budapest University of Technology and Economics, BUTE) developed a profile analysis supporting software, the ProfiSens.

The main functions of ProfiSens are the following: it creates kitchen lists for the sample preparation and score sheets for the assessors, collects data from the completed score sheets, performs statistical data evaluation and draws diagrams of the results. The language of the software is Visual Basic for Excel.

The first version of ProfiSens has been used in the 2002/2003 academic year in research, education and industrial food tests as well. In our paper we discuss the results of each mentioned field and introduce the latest developments on the software.

Keywords: food sensory testing, profile analysis, ProfiSens software

1. Introduction

Sensory testing is a relatively new but emerging field of research. Sensory quality is an important part of product potential, especially in the food industry [5, 6]. Since sensory quality is perceived by human assessors, the subjective character cannot be totally eliminated. However, several testing techniques can be applied to improve the reliability of sensory data [1, 6].

Basically there are two types of sensory tests regarding the assessors involved:

Consumer tests: untrained (naïve) assessors take part in the test, therefore the test procedure should be easy and clear, since most of the consumers have no experience in such testing. The number of samples should be limited too. Long tests involving many samples usually do not provide reliable data. To ensure representative results, the number of respondents is preferably high.

The target of consumer tests is primarily preference. The respondents give a hedonistic evaluation based on the overall impression. They answer the question '*Which product is representatively preferred*?'

Laboratory tests: trained assessors and/or experts are needed (preferably a product specific panel). The reliability of these methods is based on the training of the assessors. Tests take place in a specially designed sensory laboratory (ISO). The test structure is much more detailed than in the case of consumer researches. The number of samples might be higher, but still should be reasonable, since several sensory properties are evaluated during the tests. The target of such evaluations is the detailed sensory description of the samples; the assessors answer the question '*Why is a special product preferred*?'

2. Sensory Testing and Information Technology

Designing and implementing sensory tests can be effectively aided by the application of Mathematical Statistics as well as by IT (Information Technology) tools. Depending on the available resources, different levels of computerization are possible:

- Computerization covers only the design of the experimental plan and the questionnaires, sheets and sample codes are printed.
- Data input is computerized by OCR technology too. (Optical Character Recognition) This level includes a computerized data analysis.
- The test is performed using electronic questionnaire files, the data collection occurs by network.

3. Properties of the VBA Software Created

To avoid the extra licence fees, we decided to develop a Visual Basic for Excel software. Based on the earlier experiences of our research group we possessed the tools to avoid the usual difficulties of MS applications.

Our VBA software consists of 7 modules, 10 user forms, and works by 4 Excel worksheets, as it is shown in *Fig. 1*:

The four *Worksheets* contain

- basic documentation of the software (*Wsh1*: *Remarks*),
- sample sequences for the 3-digit random sample codes (*Wsh2*: *Permutations*),
- and the dictionary sheets for the given languages (*Wsh3*: *Hungarian* and *Wsh4*: *English*).

The language of communication can be chosen now only from two languages, but the new structure of ProfiSens – using the data of the dictionary worksheets in filling up the captions of the VBA UserForms – allows any arbitrary other language, assumed there exists a corresponding dictionary Worksheet in the ProfiSens file.

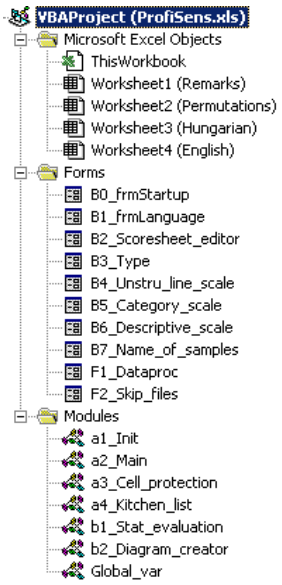

Fig. 1. Project Explorer screen of ProfiSens

The MS-Excel language version running on the user's computer is automatically tested and taken into account by ProfiSens.

- The first two UserForms control the start and the language selection (*Forms: B0_frmStart* and *B1_frmLanguage*).
- The next six UserForms are responsible for the control of the score-sheet-edition (*Forms*: *B2–B7).*
- The last two forms (*F1_Dataproc and F2 Skip_file*) control the evaluation process of the filled up score-sheet files.
- The code of the *modules a1–a4* works under the control of the *forms B2–B7* in score-sheet edition.
- The code in the *modules b1-b2* – under the control of *F1, F2 forms* – is responsible for the data evaluation process of the completed assessments, including the visualization of the diagrams.
- The global variables are defined in the *Global_var* module.

The most important new developments are introduced in *Fig. 2* and *Fig. 3*.
The new version represented in *Fig. 2* by the *B2_Scoresheet_editor* form, allows the processing of hard-copy assessments by choosing the OptionButton '*Create basic score sheet only*'. This function is very important if the user wants to process earlier profile analysis tests existing only on hard copies, or in the case when the tests are on behalf of industrial firms not allowing their newest products to transport to a sensory laboratory, and that's why we have to use hardcopy score sheets.

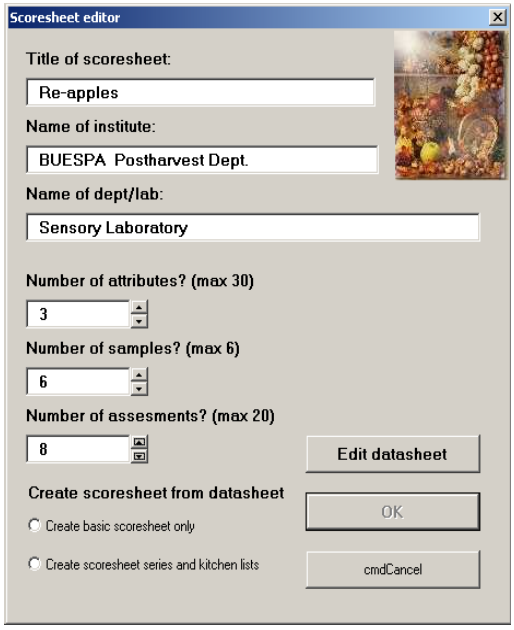

Fig. 2. B2_Scoresheet_editor Form of ProfiSens

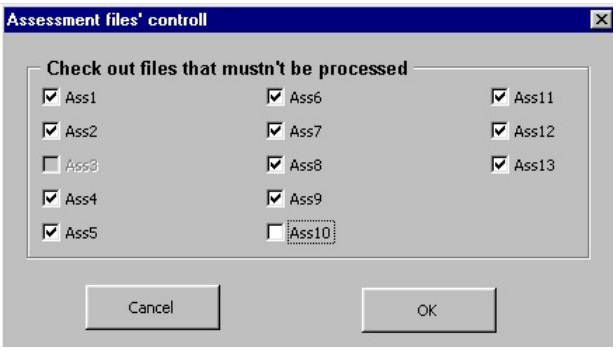

Fig. 3. F2_Skip_files Form of ProfiSens

The possibility of excluding some assessments from the evaluation process is another important new function of ProfiSens. We show a profile analysis process planned for 13 assessments in *Fig. 3*, but for a certain reason the third assessment file is missing, and the tenth should be excluded from the evaluation process – for example it could not be completed.

The new version supports a lot of other user-friendly functions as choosing the directory for the assessment files, preparing kitchen lists, or the possibility of using an unstructured line scale having not the usual 0%–100% scaling.

4. Sensory Tests in Faculty of Food Industry of BUESPA Applying ProfiSens

The first version of ProfiSens was used by some students taking part in the obligatory summer practicum 2002 at the Postharvest Department. Thereafter, we used the software in our research on the Hortus Hungaricus National Exhibition (September 2002). In the academic year 2002/2003 the teachers of the Sensory Laboratory introduced the application into the regular courses of the Faculty of Food Industry (in the Academic year 2002/2003 at SzIU, now at BUESPA). After the good experiences in applying ProfiSens, the Sensory Laboratory used it in research on behalf of other departments, or in industrial tests. In *Table 1* we show a summary about these profile analysis tests.

Table 1. Profile analysis tests supported by ProfiSens in the academic year 2002/2003

Tested food	No. of Samples	No. of Assessments	Month/No. of Prof. Anal.
Apple	4	8	July (1A)
Sour cherry	4	4	July (1A)
Apple	6	17	Sept. (1A)
Grape-juice	3	20 (*2)	Oct. (2A)
Apple	4	12 (*6)	Nov. (6A)
Apple	4	20	Jan. (1A)
Apple	6	16 (*4)	Feb. (4A)
Cucumber	6	24 (*2)	Mar. (2A)
Apple	4	16	Mar. (1A)
Cucumber	4	16 (*2)	Mar. (2A)
Yoghourt	5	18 (*2)	Mar. (2A)
Yoghourt	4	17	Mar. (1A)
Vegetables	4	16	Apr. (1A)
Salad mix	6	15	May (1A)
Apple	4	16	May (1A)
Apple	6	16 (*2)	May (2A)
Pepper	6	7	May (1A)
	Samples	Assessments	Analyses
Total	80	460	30

The summary of the profile analyses shown in *Table 1* does not contain the tests carried out on behalf of industrial firms, as in the industrial tests we investigated new products before introducing them into the market.

Some representative examples of the evaluation by ProfiSens are shown in *Figs. 4*, *5* and *6* (sour cherry). Four different sour cherry varieties were tested the number of attributes was 8, as it is shown in *Fig. 5*.

A more complete representation of the ProfiSens' outputs is shown for the

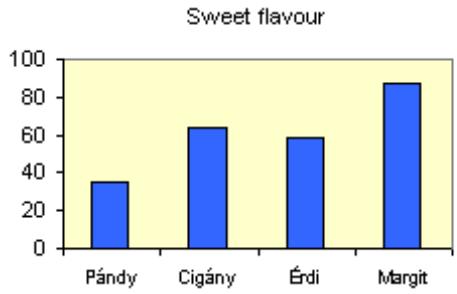

Fig. 4. Sweet flavour of sour cherry samples (unstructured linear scale)

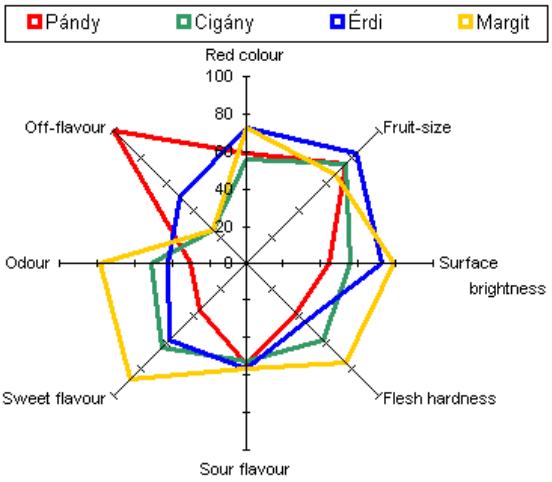

Fig. 5. Fruit size of sour cherry samples (category scale)

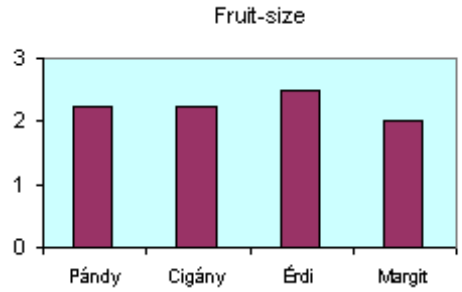

Fig. 6. Comparison of attributes by ProfiSens in profile analysis of sour cherry varieties

profile analysis of grape juice [8]. In this case the effect of different treatments was investigated.

For the red grape-juice samples nine attributes were investigated and evaluated by ProfiSens. Three of them are shown in *Table 2* and in *Figs. 7, 8* and *9*. The effect of the treatments is obvious in the cases of muddiness and flavour, but ANOVA does not show any significant difference in the case of the attribute 'Off-flavour'.

Table 2. Significant differences of selected grape-juice attributes from the output data of ProfiSens

Muddiness $sd(5\%) = 18.0$ $sd(1\%) = 23.9$					
	Ave.	Var.	No treat	1.treat	2.treat
No treat.	47.3	911.5	–	5%	1%
1. treat.	67.1	704.6	19.8	–	no
2. treat.	78.9	800.0	31.6	11.8	–

Flavour $sd(5\%) = 12.6$ $sd(1\%) = 16.8$					
	Ave.	Var.	No treat	1.treat	2.treat
No treat.	86.4	231.3	–	1%	1%
1. treat.	68.2	527.3	18.2	–	1%
2. treat.	50.6	437.1	35.8	17.6	–

Off-flavour $sd(5\%) = 16.6$ $sd(1\%) = 22.1$					
	Ave.	Var.	No treat	1.treat	2.treat
No treat.	21.9	1036.4	–	no	no
1. treat.	14.9	573.0	7.1	–	no
2. treat.	14.0	455.1	7.9	0.9	–

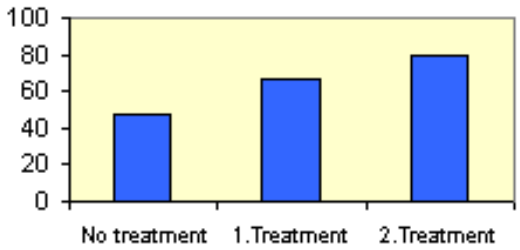

Fig. 7. Muddiness of Grape-juice

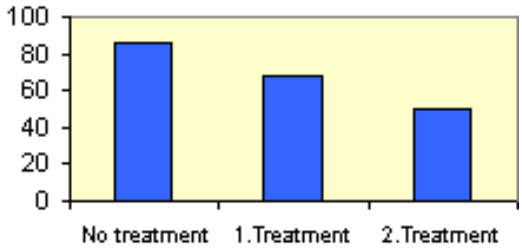

Fig. 8. Flavour of grape-juice

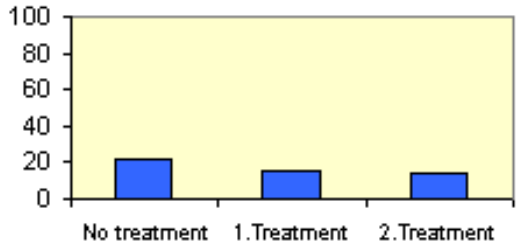

Fig. 9. Off-flavour of grape-juice

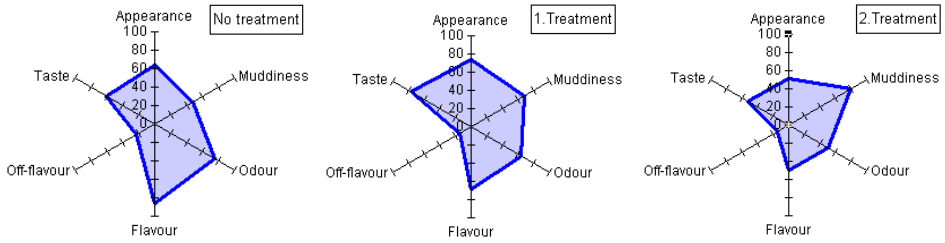

Fig. 10. The nine attributes investigated for grape juice. ProfiSens represents the selection by samples.

5. Software Supporting both Consumer and Laboratory Sensory Tests

As in 2002 autumn the 'profile analysis' on the Hortus Hungaricus Exhibition was a first attempt to use ProfiSens in non-laboratory circumstances, we had a connection point to this event in 2003, too. The researchers of the Postharvest Department (BUESPA) made ranking tests again with more than 400 assessors. The fast evaluation of these numerous questionnaires involved a common development [3, 4, 7], which can be switched by a simple interface to ProfiSens as well. Whenever we use the Friedman test to investigate significant differences between the samples with respect to the different attributes, we use the same algorithm in evaluation and

in the visualization of the results. The created new software made it easy to carry out the numerical part of statistical methods in the case of the huge data amount of ranking tests and at the end of the profile analysis.

6. Discussion

The experiences in developing, execution and processing more than 400 assessments and now more than 30 testing occasion verified that the ProfiSens sensory analysis supporting software can successfully be used in research, education and industrial testing. ProfiSens considerably reduced the time demand of the preparation, testing and evaluation steps. The possibility to process hard-copy (paper-based) test sheets by the software makes easier to report also industrial tests. Through the contacts in our research groups we started to create common developments with other sensory test supporting methods. The applied IT tools improved the efficiency of research concerning the market potential of new fruit or vegetable varieties and new formulas in food industry.

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List of Symbols and Abbreviations

Ave.	Average
BUESPA	Budapest University of Economic Sciences and Public Administration
BUTE	Budapest University of Technology and Economics
IT	Information Technology
LAN	Local Area Network
sd	Significant difference
SzIE	Szent István University
treat.	treatment
Var.	Variance
VBA	Visual Basic for Application

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