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APPLICATION OF FUZZY METHOD IN THE SPECTROPHOTOMETRICAL RESEARCH OF BIOLOGICAL OBJECT

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Adsorption spectra of tobacco's alhogol infusion has been received in visible range. Linear dependence between spectroscopy parameters and tobacco quality has been found. Based on spectroscopy dates using theory of Fuzzy method, clear borders tobacco classification by its quality.

INTRODUCTION

One of actual directions of modern development of technological advance is the elaboration of intellectual decision support systems, data analysis and control of difficult processes, based on logical linguistic simulation of methods and decision-making processes by the person. The elaboration of similar systems requires development of methods of representation and processing of human opinions as well as formalizing of uncertainty intrinsic to these opinions. At present new opportunities with application of spectral methods for the analysis of chemical composition and quality of tobacco appeared [1]. These methods are most sensitive informative and expressive for documentary grade identification of quality and respectively for an estimation of smoking qualities. It is necessary to note that the tobacco raw kind is inhomogeneous on the frame and structure, on which processes of drying and fermentation influence strongly [2]. In connection with that the optical parameters describing documentary grade of quality of raw vary in definite intervals of values. Therefore for identification and standardizing of quality (documentary grade of quality and smoking qualities) tobacco most appropriate is a computational method usage of the vehicle of theory of indistinct sets based on optical parameters.

A lot of works are dedicated to a problem of processing and representation of the indistinct data to databases [3-5]. Though there are a lot of works on indistinct databases, but most of all are theoretical. There are no works on regarding problem of operation an indistinct DB in a structure of concrete intelligence systems.

In [6] the indistinct database is represented on the basis of relational model. The relational algebra, except for customary operations also contains indistinct operations. In the database the indistinct data are introduced by functions of a fitting.

The illegibility and uncertainty in relational relations, representation of rules of logical conclusion are investigated in [4]. In [7] the theoretical aspects of the indistinct inquiries processing are investigated. The special attention is given to representation of inquiries of dynamic nature. Operations of indistinct algebra and graphic representation of indistinct operations is shown in [8].

The article is dedicated to practical aspect of processing and representation of the indistinct data. Let's consider application of a Fuzzy method at a spectrophotometric analysis of tobacco quality.

EXPERIMENTAL

We obtained absorption spectra of alcohol tobacco extracts. Selection of alcohol as a solvent is conditioned, that it is transparent in investigated spectral range 400-750nm and gives stable absorption of tobacco at 665nm.

If suppose that the Bouguer-Lambert-Beer low is operated regarding for this band the concentration of residual chlorophyll in investigated samples of tobacco was characterized by absorbency (A) at λ=665nm. Thus the weight concentration of granulated leaves of tobacco in alcohol extracts was identical. The spectra are recorded in cells with the bed depth 0,5cm several times and determined average arithmetic value of absorbencies D_{665} on the basis of a method of reference basic lines. The measurements were carried out on the spectrophotometer Specord "UV VIS".

As an example about 100 models of a skeletal and aromatic type of six kinds brought up in different zones of Azerbaijan were studied. Smoking qualities (taste, flavor) and documentary grade of quality were determined by commission of special tasting of the Baku tobacco centre.

RESULTS AND DISCUSSION

In a Fig. 1 the absorption spectra of three tobaccos types are shown, distinguishing by the smoking qualities. It is clearly shown, that the tobacco of pure quality has the more intensity of absorption line at λ=665nm. It is necessary to note, that the band of absorption in λ=665nm is conditioned by residual chlorophyll (plenty of potherb). The high residual chlorophyll contents leads to considerable accumulation of materials with negative properties in tobacco to the detriment of positively of operational components.

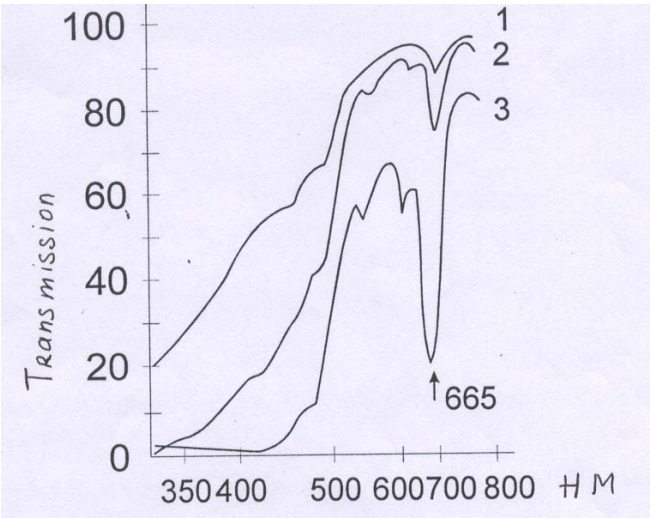

Fig.1.

Absorption spectra of alcohol extracts of tobacco such as Trapezond in visible region: 1-maiden kind (variety), 2-second kinds (varieties), 3-third kinds (varieties)

For classification of tobacco's quality grade and definition of its class value D_{665} was used as the criterion. The values of D, obtained for different kinds of tobacco are indistinct, taking more or less interquartile values, they vary in definite intervals. In Fig.2 the results of classification of tobacco with different documentary grade of quality using method of the theory of indistinct sets are graphically shown [9]. Thus, used trapezoidal submission (representation) of a function of belonging of indistinct value analytically depicted by the data (m_1, m_2, α, β, L), where m_1 and m_2 respectively, lower and upper modal values of an indistinct interval, where M - respectively left-right coefficient of an illegibility, L-high of an indistinct interval.

The value of L is defined by the below – mentioned formula.

$$\mathrm{Poss}(\mathrm{al}/\mathrm{a2}) = \max\min\left(\mu_{al}(u), \mu_{a2}(u)\right) \in [0,1] =$$

$$= \begin{cases} 1 - \dfrac{\mathrm{ml}_1 - \mathrm{mr}_2}{б_1 + в_2}, & \text{if} \quad 0 \prec \mathrm{ml}_1 - \mathrm{mr}_2 \prec б_1 + в_2 \\ 1, & \text{if} \quad \max(\mathrm{ml}_1, \mathrm{ml}_2) \le \min(\mathrm{mr}_1, \mathrm{mr}_2) \\ 1 - \dfrac{\mathrm{ml}_2 - \mathrm{mr}_1}{б_2 + в_1}, & \text{if} \quad 0 \prec \mathrm{ml}_2 - mr_1 \prec б_2 + в_1 \\ 0, \end{cases} \tag{1}$$

where

$$\mu_{al}(u) = \begin{cases} 1 - \dfrac{\mathrm{ml}_1 - \mathrm{u}}{б_1}, & \text{if} \quad \mathrm{ml}, - б_1 \le \mathrm{u} \le \mathrm{ml}_1, \\ & \text{if} \quad \mathrm{ml}, \le \mathrm{u} \le \mathrm{mr}_1 \\ 1 - \dfrac{\mathrm{u} - \mathrm{ml}_1}{б_1}, & \text{if} \quad \mathrm{mr}_1 \le \mathrm{u} \le \mathrm{mr}_1 + в_1 \\ 0, \end{cases}$$

$$\mu_{a2}(u) = \begin{cases} 1 - \dfrac{\mathrm{ml}_2 - \mathrm{u}}{б_2}, \ \text{if} \mathrm{ml}_2 - б_2 \le \mathrm{u} \le \mathrm{ml}_2 \\ 1, \quad \text{if} \ \mathrm{ml}_2 \le \mathrm{u} \le \mathrm{mr}_2 \\ 1 - \dfrac{\mathrm{u} - \mathrm{mr}_2}{в_2}, \ \text{if} \quad \mathrm{mr}_2 \le \mathrm{u} \le \mathrm{mr}_2 + в_2 \\ 0, \end{cases} .$$

So, a_1, a_2 is considered as flat fuzzy numbers which $a_1=(ml_1, mr_1, \alpha_1\beta_1)$, $a_2=(ml_2, mr_2, \alpha_2,\beta_2)$, ml_1, mr_1 and ml_2, mr_2 are the mean values. $\alpha_1\beta_1$ and α_2,β_2 are the left and right spreads of fuzzy numbers a_1, a_2 respectively, $\mu a_1(u)$ and $\mu a_2(u)$ are functions of belonging of the linguistic values a_1 and a_2 respectively. These operations except for the last one, were discussed in [8]

The definition of quality was obtained with use of the above-mentioned formula and Fig.2.

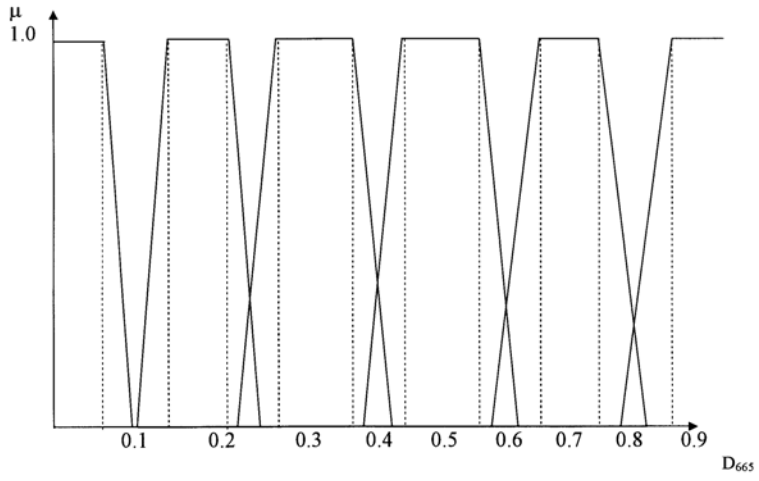

Fig.2.
The chart of classification of tobacco from different documentary grade of quality on absorption spectra of alcohol extracts.

The obtained values of figure of tobacco quality (value of a function of a belonging) on the basis of design formulas are given in Table 1.

Table1.

Values of a function of a fitting on the basis of design formulas (1).

Lives	First kind	I kind (μ)	II kind (μ)	III kind (μ)	IV kind (μ)	V kind (μ)
Leaf 1	1	0.8	0.5	0.2	0.1	0.9
Leaf 2	0.1	0.7	0.6	0.4	0.7	0.5
Leaf 3	0.7	0.1	0.3	0.8	0.5	0.7
Leaf 4	0.9	0.9	0.8	0.5	0.2	0.1

Example. Definition which leaves are satisfied to the requirements I and II kind. We select leaves as it membership function value greater than α (we took α to be equal to 0.5)

Table 2.

Determination leaves relating to I and II kind.

Leaves	First kind	I kind (μ)	II kind (μ)	III kind (μ)	IV kind (μ)	V kind (μ)
Leaf 1	1	0.8	0.5	0.2	0.1	0.9
Leaf 2	0.1	0.7	0.6	0.4	0.7	0.5
Leaf 4	0.9	0.9	0.8	0.5	0.2	0.1

The belonging to different documentary grade of quality can be represented in following form:

(0.03	0.09	0	0.01	1.0)	First kind
(0.14	0.20	0.03	0.03	1.0)	I kind
(0.25	0.35	0.03	0.06	1.0)	II kind
(0.47	0.65	0.06	0.02	1.0)	II kind
(0.70	0.83	0.03	0.03	1.0)	IV kind
(0.86	0.92	0.03	0.01	1.0)	V kind

Fuzzy the method was also used for the control of improvement of tobacco raw quality by MICROWAVE-DRYING [10]. Thus, the optimal parameters and mode of a very high frequency of drying permitting to receive a non-polluting, qualitative main product were determined.

So, with the use of the above -mentioned formula and parameters of the quality of tobacco we can possibly diagnose the qualities of tobacco with enough reliability.

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BİOLOJİ OBYEKTLƏRİN SPEKTROFOTOMETRİK TƏDQİQİNDƏ QEYRİ – SƏLİS ÇOXLUQLAR NƏZƏRİYYƏSİNİN TƏTBİQİ

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Tütünün spirt cövhərinin görünən oblastda udulma spektrləri alınmışdır. Spektrofotometrik parametrlərlə keyfiyyət göstəriciləri arasında xətti asılılıq tapılmışdır. Bu spektrofotometrik parametrlərə əsaslanaraq qeyri-səlis sistemlər çoxluğu metodu ilə tütünün keyfiyyəti görə dəqiq növləşdirmə sərhədləri müəyyən olunmuşdur.

ПРИМЕНЕНИЕ МЕТОДА НЕЧЕТКОЙ ЛОГИКИ В СПЕКТРОФОТОМЕТРИЧЕСКОМ ИССЛЕДОВАНИИ БИОЛОГИЧЕСКОГО ОБЪЕКТА

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Получены спектры поглошения спиртового экстракта табака в видимой области. Найдена линейная зависимость между спектрофотометрическими параметрами и показателями качества. Основываясь на спектрофотометрических данных методом нечетких множеств были определены четкие границы классификации табака по качеству.

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