OPTIMIZATION OF THE RECIPE AND DETERMINE THE PRICE OF THE PROPHYLACTIC NECTAR USING FUZZY SETS

***[1]Baychenko L.A., [2]Baychenko A.A, [2]Aret V.A.**

[1]National Research University of Information Technologies, Mechanics and Optics – Saint-Petersburg, Russia
[2]Institute of Refrigeration and Biotechnologies

***Baychenko L.A., larabaychenko@yandex.ru**

Abstract: The article shows how to use the theory of fuzzy sets for the optimization of the prophylactic nectar recipe and determine the nectar price.
Keywords: nectar, optimization, price, fuzzy sets.

Proactive fruits and berries nectar, "Vitanekt", as shown by medical and biological research [1], is useful for people who come into contact with phenol and aniline, but because of the need to consume this product on a regular basis, for example, workers of metallurgical plants, it is important to make the product attractive to taste and price. Known methods of organoleptic evaluation by experts from the mathematical point of view leads to the concepts of fuzzy set theory [2]. As a result of organoleptic evaluation of prophylactic nectar "Vitanekt" by tasters It was obtained three estimates of the matrix of the form.

Table 1. The table shows the three pairs of fuzzy sets, which take some of the informative value of relative content of components 1 and 2 in the nectar Vitanekt and its price

Designation of the matrix	Indicators	Arithmetic mean values of indicators						
$\mu 1$ - matrix ingredient 1	The content mg/100 g, g	20	21.4	23	25	27.2	28.6	30
	Mean estimates of experts	0.12	0.32	0.68	0.88	0.82	0.38	0.06
$\mu 2$ - matrix ingredient 2	The content mg/100 g, b	10	11.7	13.4	15	16.7	18.4	20
	Mean estimates of experts	0	0.33	0.65	1	0.63	0.32	0
$\mu 3$ - matrix price	Price of nectar rub/100 g, h	3.5	4	5	6	10	20	30
	Mean estimates of experts	1	1	1	1	0.64	0.35	0

Experts opinions were the extent of accessories: a tasty -1, -0.8 almost tasty, not very tasty - 0.3, and tasteless - 0, and -1 is cheap, very cheap - 0.8, a little expensive - 0.3, is too expensive 0. As the are five experts, their estimates differ, and the table already given expectations of expert evaluations. We apply the matrix estimates $\mu 1$ of the membership function in the form of a normal distribution and the program Mathcad 14. In the notation of the program: where g - the content of an ingredient in table number 1,

$$\mu g(g, A1, B1) := \exp\left[-A1 \cdot (B1 - g)^2\right] \quad (1)$$

where: A1 - the statistical variance of row g in table number 1, B1 - the arithmetic mean of row g in table number 1.

The calculation gave a value of 25,029 = B1, A1 = 0.083. Figure 1 shows that the broken line a solid line that passes through the experimental points are well approximated by a membership function as a normal distribution (dotted line).

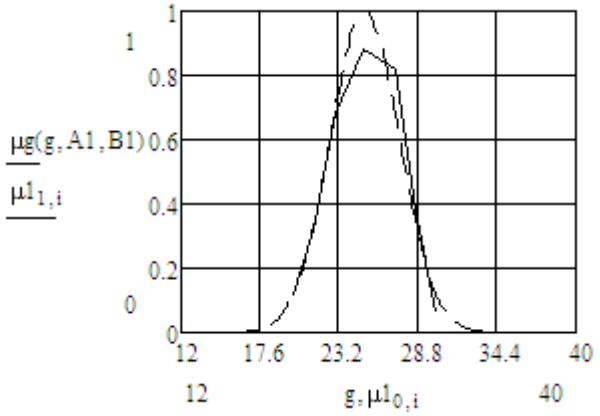


Fig. 1. A comparison of membership functions $\mu g(g, A1, B1)$ and fuzzy set of points $\mu 1$ from the table number 1.

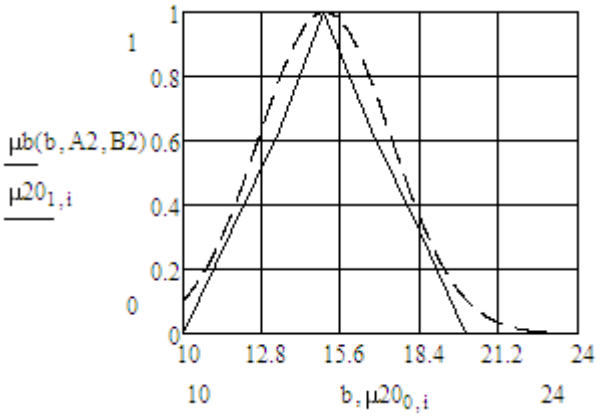
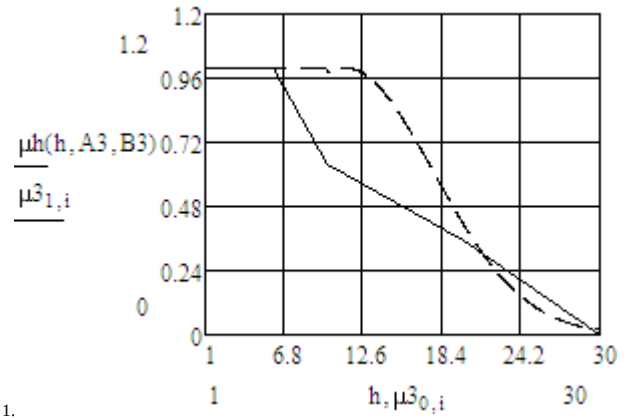


Fig. 2. A comparison of membership functions $\mu b(b, A2, B2)$ and fuzzy set of points $\mu 2$ from the table number 1. A2 = 0.09, R2 = 15.03

According to the table number 1 evident that for a fuzzy set, you can not construct a simple membership function, as for the previous two. Not stopping at the intermediate operations, we present the form of the function (3) supplies for the second set in the notation of Mathcad 14 and the graph of this function in Figure 2:

$$\mu h(h, A3, B3) = if\left[h \le 12{,}6, \mu h0(h, A3, B3)\right] \tag{2}$$

where h - the price in the table number 1,
A3 - the statistical variance of the right side of the table row number 1 h,
B3 - arithmetic mean of the right side of the h in table number



1.

Figure 3. A comparison of membership functions $\mu h(h, A3, B3)$ and fuzzy set of points $\mu 3$ from the table number 1. A3 = 0.011, B3 = 11.21

In order to find the intersection of three optimization of membership functions as a function of three variables:

$$\mu gbh(g,b,h) = \min\begin{pmatrix} \mu g(g, A1, B1) \\ \mu b(b, A2, B2) \\ \mu h(h, A3, B3) \end{pmatrix} \quad (3)$$

Write a program to calculate with Matkade. The program includes the value of G0 - is the maximum value of the function (3). In the end we get a three-dimensional membership function, where G1 = 25, and G2 = 15 - the best quantity of ingredients in terms of of experts, and G3 = 3,5 the best price.

This result is seemingly predictable it is natural that experts believe the best price minimum -3.5 rub. But what's important - the third schedule of supplies (Figure 3) shows that even at the price the of 6.5 consumer is inclined to buy the nectar and at 12 rubles and higher number of applicants drops, what should be considered when building a sales plan, marketing. The other elements of the vector from the position of the biotechnology assessment formulas are important. The example shows that the theory of fuzzy sets allows optimization of factors entirely different nature, using the same expert in one of the simultaneous session.

References

1. Kolodyaznaya V.S., Baĭchenko L.A. Retseptury i tekhnologiya plodovo-yagodnykh nektarov, obogashchennykh biologicheski aktivnymi veshchestvami dlya profilaktiki vrednogo vozdyeĭstviya fenola i anilina na organizm cheloveka. Izvestiya Sankt-Peterburgskogo gosudarstvennogo agrarnogo universiteta.- № 25 - 2011.- S.24-31.

2. Zade L. Ponyatie lingvisticheskoĭ peremennoĭ i yee primenenie k prinyatiyu priblizhennykh reshenиĭ. M.: Mir, 1976. – s. 165