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## 11.2 Antioxidant characteristics of uncommon types of vegetable plants for restaurant technology

**Introduction.** Currently, the use of plant-based ingredients in gastronomy is very important [370-373]. The current demand for high-quality of vegetable plants involves the development of new production technology methods for improved quality control, environmental friendliness, higher energy efficiency, lower cost, and safer operations [374, 375]. These methods will allow to preserve biologically active substances – volatile aromatic substances, phenolic compounds, reduce their loss and increase organoleptic properties [376, 377]. These biologically active substances are very sensitive to production conditions, especially to solvents – water, ethanol, water-alcohol mixtures. Therefore, the conditions required to efficiently extract these compounds vary from plant to plant, which is an important point in the extraction process [378]. Despite some achievements, there are still many problems related to the production of pungent aromatic botanical raw materials with antioxidant capacity. These are rare plant crops in Ukraine and unconventional for restaurant technology.

Spicily-aromatic vegetable raw materials contain a variety of chemical substances with a wide range of biological activities. They are gaining more and more attention from scientists and consumers due to their antioxidant properties. The ability of plant phenols to act as free radical scavengers has led to increased interest in their ability to act as antioxidants. Antioxidants reduce the emission of oxidation products: hydroperoxides, alcohols, aldehydes, ketones, fatty acids.

Currently, the antioxidant properties of all prescription ingredients, food additives, bioactive substances, and combinations thereof have not been adequately studied. These circumstances determine the relevance of this work aimed at developing water-alcohol extracts of vegetable raw materials for restaurant technology.

*The aim* of the research is to determine the prospects of uncommon types of vegetable plants with increased antioxidant capacity for restaurant technology.

**Materials and methods.** *Materials.* The following types of uncommon types of

vegetable plants were used in the research: medicinal hyssop (*Hyssopus officinalis L.*), Moldavian snakehead (*Dracocephalum moldavica L.*), anise lofant (*Agastache foeniculum L.*), lemon balm (*Melissa officinalis L.*), cornflower real (*Ocimum basilicum L.*), vegetable fennel (*Foeniculum vulgare Mill.*), vegetable chrysanthemum (*Glebionis coronaria L.*), garden thyme (*Satureja hortensis L.*).

*Description of research procedure*. The drying period of all studied plants, under natural conditions, was 6 – 8 days to a humidity of 12–14%. The collected and inspected raw materials were laid out on clean white paper, each type separately.

The first stage – the preparation of infusions. Plant raw materials were minced into a size of 3x3 mm, suspensions of 4 g were placed into the glass bottles, were filled by 100 ml of alcohol solvent with volume fraction of rectified ethyl alcohol 40 %. The resulting infusions were cooled to 20 °C for 7 days, stirring periodically [379].

Next, the infusions were filtered and studies were performed to determine the indicators of active acidity, which was measured on a *pH* meter in the mode of *pH* measurement with a combined glass electrode. The redox potential (*RP)* was measured in the potential measurement mode with a combined redoxmetric platinum electrode [379].

Determination of sugar content – according to Bertrand [380].

Determination of ascorbic acid content – indophenol method [381].

*Expert method of sensory evaluation*. The expert method of determination of values of indexes of quality is based on the account of opinions of group highly skilled specialists-experts [382].

**Results and discussion.** *Antioxidant capacity.* Figure 1 show graphically the change in the physicochemical indicators of the quality of extracts of spicy-aromatic raw materials on the extractant.

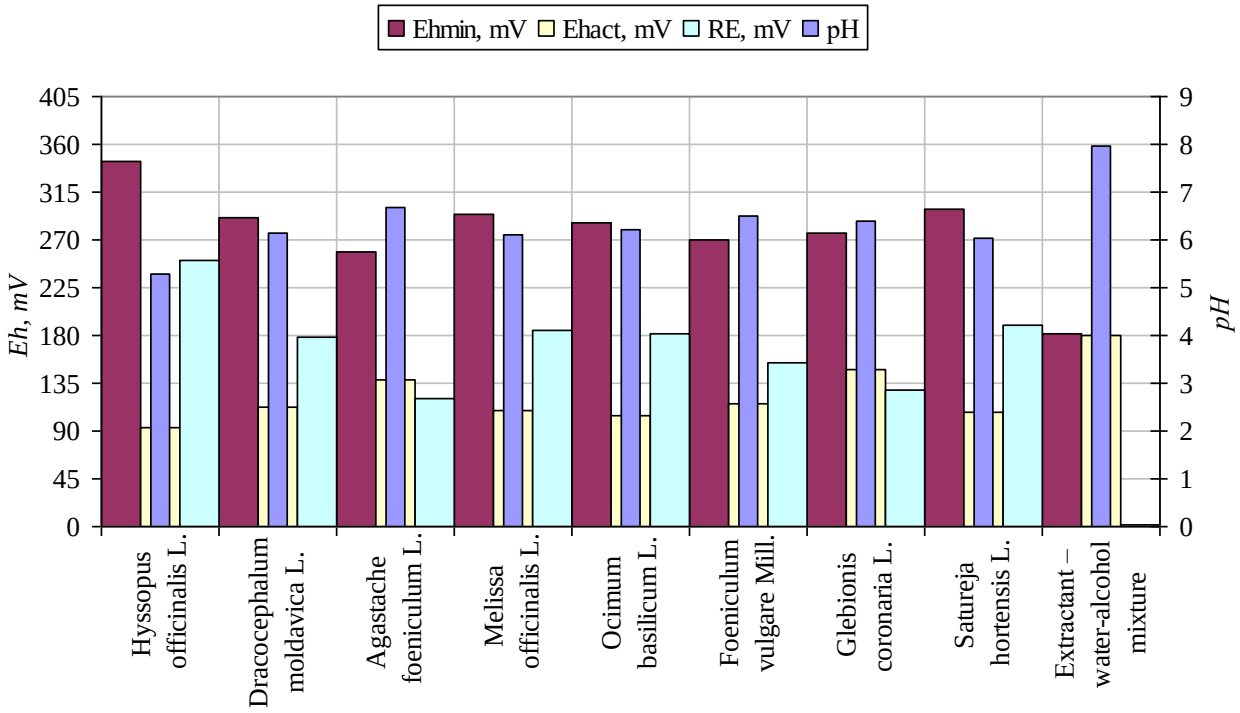


Figure 1. Quality indicators of extracts on extractant: *pH* – active acidity of the test solution; $Eh_{min}$ – minimal theoretically expected meaning of *RP*; $Eh_{act}$ – actual measured *RP*; *RE* – recovery energy

The minimum theoretical value of *RP* ($Eh_{min}$) for plant water-alcohol infusions was obtained, which has a value from 258.6 mV (*Agastache foeniculum L.*) to 343.2 mV (*Hyssopus officinalis L.*). The actual measured *RP* of infusions ($Eh_{act}$) was established – from 93 mV (*Hyssopus officinalis L.*) to 148 mV (*Glebionis coronaria L.*). The hydrogen index for water-alcohol infusions from spicy-aromatic raw materials has a value of 5.28 units *pH* (*Hyssopus officinalis L.*) to 6.69 units *pH* (*Agastache foeniculum L.*) [383].

Water-alcohol infusions from vegetable raw materials and a volume fraction of ethanol of 40% have the value of regenerative capacity (recovery energy – *RE*) in the range from *RE* – 120.6 mV (*Agastache foeniculum L.*) to *RE* – 250.2 mV (*Hyssopus officinalis L.*). For the restaurant business in the manufacture of beverages are promising water-alcohol infusions of *Hyssopus officinalis L.* and *Melissa officinalis L.*, which received increased antioxidant characteristics *RE* – 250.2 mV and *RE* – 184.6 mV, respectively, and positive sensory evaluation (*S.e.*) – 9.53 and *S.e.* – 9.68

points [383].

*Preservation of biologically active substances in spicy-aromatic plants after drying.* We know that significant losses (from 20 to 80%) of volatile aromatic substances, phenolic compounds and other biologically active substances are observed during processing and storage of spicy vegetables [384, 385]. Table 1 presents a comparative assessment of the quality of fresh and dried plants.

Table 1

Comparative assessment of the quality of fresh and dried spicy-aromatic plants, based on dry matter

| The name of plant raw materials | Total sugar, % | | | Ascorbic acid content, mg/100 g | | |
|---|---|---|---|---|---|---|
| | before drying | after drying | preservation, % | before drying | after drying | preservation, % |
| *Hyssopus officinalis L.* | 2.97 | 0.80 | 26.94 | 47.95 | 0.62 | 1.29 |
| *Dracocephalum moldavica L.* | 2.46 | 0.50 | 20.33 | 57.01 | 0.57 | 1.00 |
| *Agastache foeniculum L.* | 2.73 | 0.75 | 27.47 | 61.14 | 0.86 | 1.41 |
| *Melissa officinalis L.* | 2.79 | 0.80 | 28.67 | 21.11 | 0.23 | 1.09 |
| *Ocimum basilicum L.* | 1.80 | 0.44 | 24.44 | 32.30 | 0.29 | 0.90 |
| *Foeniculum vulgare Mill.* | 2.30 | 0.50 | 21.74 | 70.44 | 0.56 | 0.80 |
| *Glebionis coronaria L.* | 2.03 | 0.46 | 22.66 | 39.26 | 0.71 | 1.81 |
| *Satureja hortensis L.* | 2.21 | 0.75 | 33.94 | 22.61 | 1.00 | 4.42 |

According to the results of the analysis, the percentage of total sugar retention of the experimental plants was: for *Satureja hortensis L.* – 33.94 %, *Melissa officinalis L.* – 28.67 %, *Agastache foeniculum L.* – 27.47 %, *Hyssopus officinalis L.* – 26.94 %, *Ocimum basilicum L.* – 24.44 %, *Glebionis coronaria L.* – 22.66 %, *Foeniculum vulgare Mill.* – 21.74 % and *Dracocephalum moldavica L.* – 20.33 %. After drying, the retention of ascorbic acid was low and ranged from 0.80 % (*Foeniculum vulgare Mill.*) to 4.42 % (*Satureja hortensis L.*).

Compositions for restaurant technology in the production of tea-herb compositions, white and red sauces, compotes of increased biological value and improved sensory characteristics have been developed on the basis of spicy and aromatic plant raw materials.

*Sensory evaluation of tea-herbal compositions with the addition of spicy-aromatic vegetable raw materials*. The results of sensory evaluation (*S.e.*) of tea-herbal compositions are shown in Figure 2.

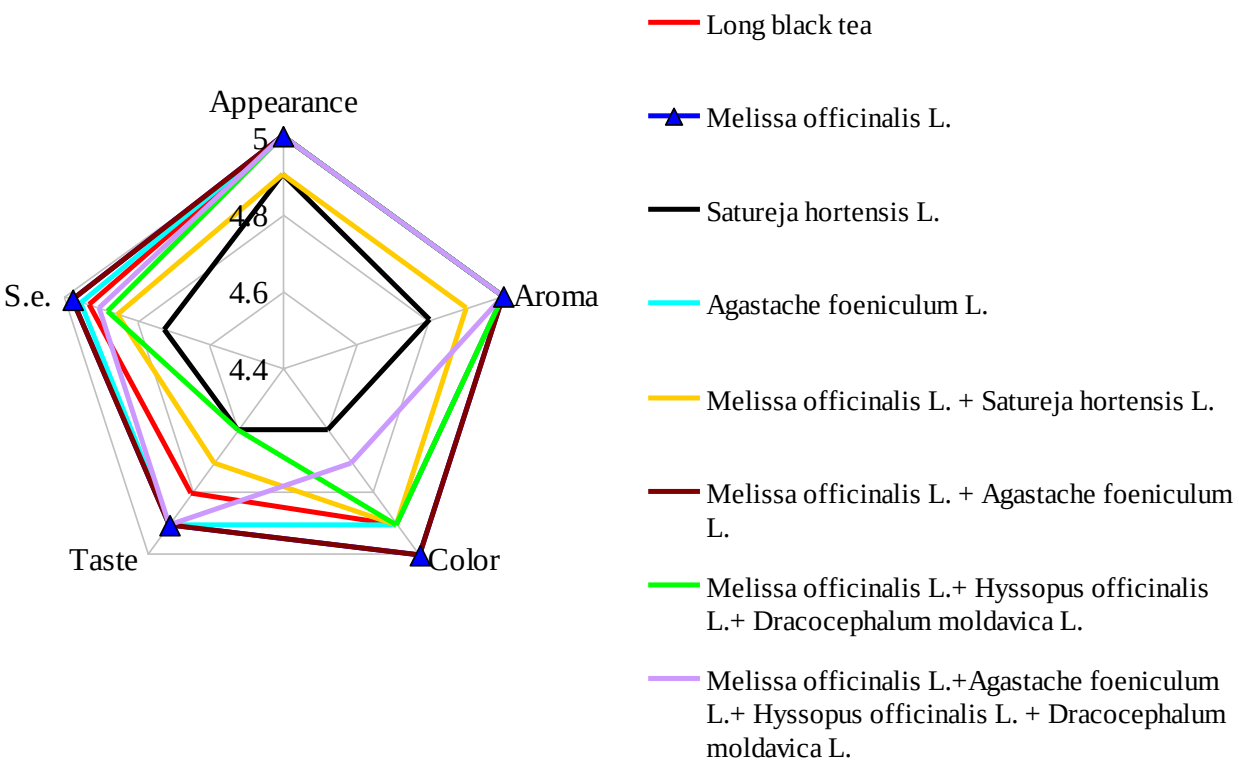


Figure 2. Sensory evaluation of tea-herbal compositions

The highest score was obtained by tea-herbal compositions based on *Melissa officinalis L.* and a mixture of *Melissa officinalis L.+Agastache foeniculum L.* (1:1) – *S.e.* 4.98 points. The prospect of creating herbal tea compositions is confirmed by our research [382].

*Sensory evaluation of white main sauce with the addition of spicy-aromatic vegetable raw materials.* Evaluation of spicy-aromatic plants in mixtures showed that unsurpassed in taste, aroma and overall tasting evaluation of white main sauce based on meat broth with the addition of spicy spices (bay leaf, black peas, ground black

pepper) and experimental samples of plants (broth) from beef + bay leaf + black pepper peas + ground black pepper + greens + *Hyssopus officinalis L.* + *Ocimum basilicum L.* + *Dracocephalum moldavica L.*) (Figure 3).

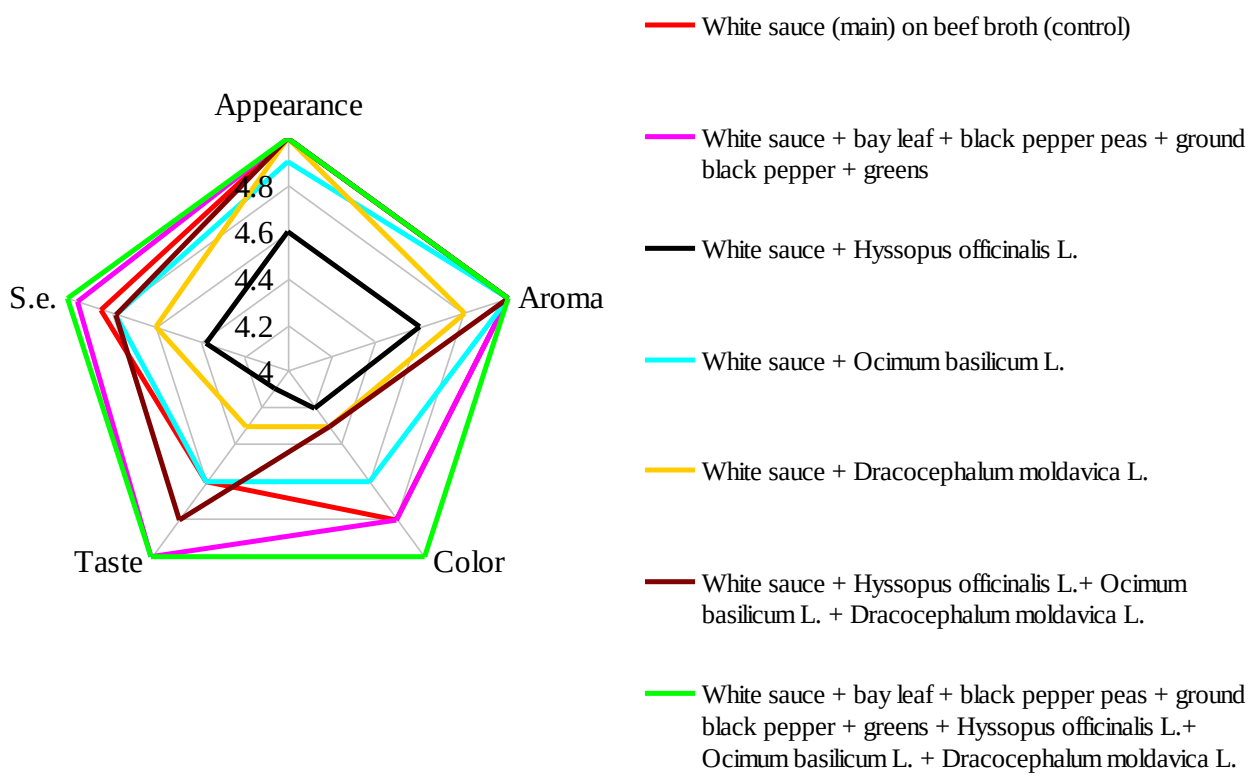


Figure 3. Sensory evaluation of white main sauce

Spicy and aromatic vegetable stock is undeniably biologically valuable, which is not traditional for restaurants. Substances with antibacterial, antioxidant and hepatoprotective properties are present in the composition, used in small daily doses to improve digestion. They do not cause allergies and have a positive effect on the physical and mental state of a person. Research has demonstrated the value and availability of spicy and aromatic plant ingredients in culinary dishes and can successfully replace or complement traditional spice combinations.

*Sensory evaluation of red main sauce with the addition of spicy-aromatic vegetable raw materials.* The addition of spicy-aromatic vegetable raw materials to the red main sauce significantly enriched it and increased the tasting score (Figure 4).

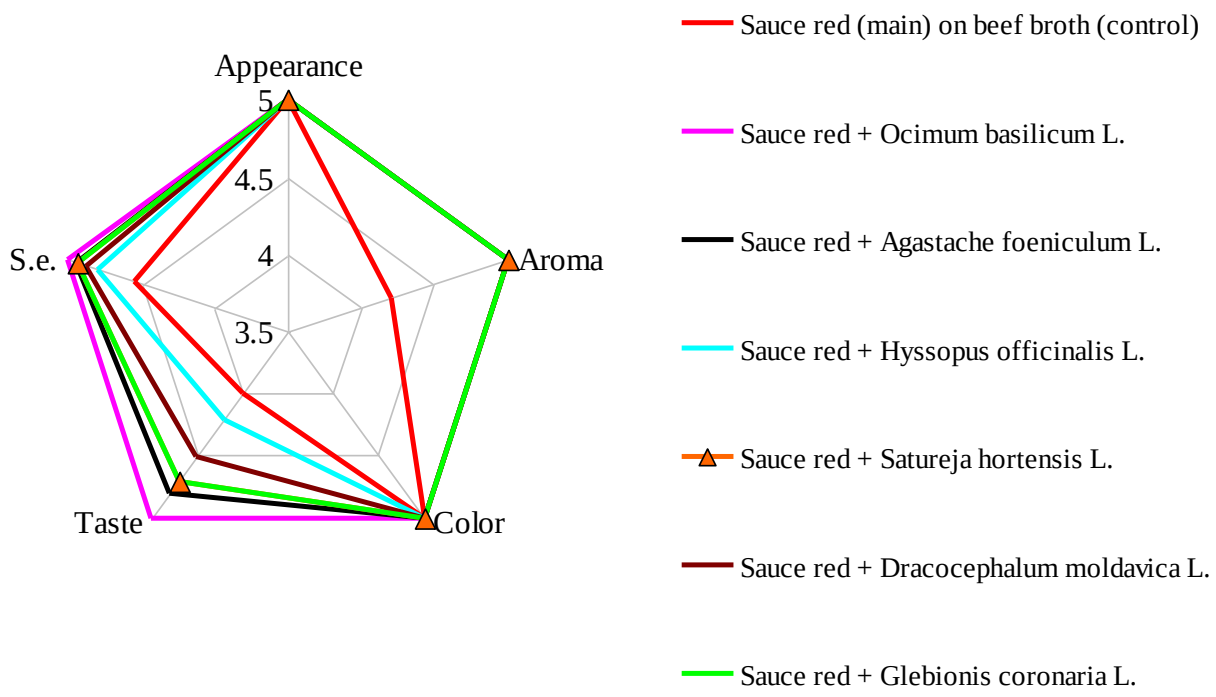


Figure 4. Sensory evaluation of red main sauce

For the production of red main sauce used a hybrid of tomatoes «Maximato $F_1$», which have an increased dry matter content – 5.2 %; total sugar – 3.0 %; vitamin C content – 20.9 mg/100 g; total acidity – 0.51 %, which significantly exceeds other tomato hybrids.

To enrich the aroma and taste of the red main sauce, it is recommended to add spicy-aromatic herbs, especially *Ocimum basilicum L. S.e.* – 5,00 points.

*Sensory evaluation of compotes with addition of spicy-aromatic vegetable raw materials.* Traditionally, the healing drink in Ukraine is dried fruit compote. The aroma and taste of compotes were improved by adding spicy-aromatic vegetable raw materials (Figure 5).

The samples with the addition of spicy-aromatic herbs in aroma, color and taste were at the level of control (compote made from dried apples), slightly lower scores on aroma and taste can be considered insignificant compared to the fact that herbs significantly enriched the biochemical composition of the product. The specimen with the addition of *Agastache foeniculum L.* (S.e. – 5,00 point), which was better than the

control, was especially distinguished.

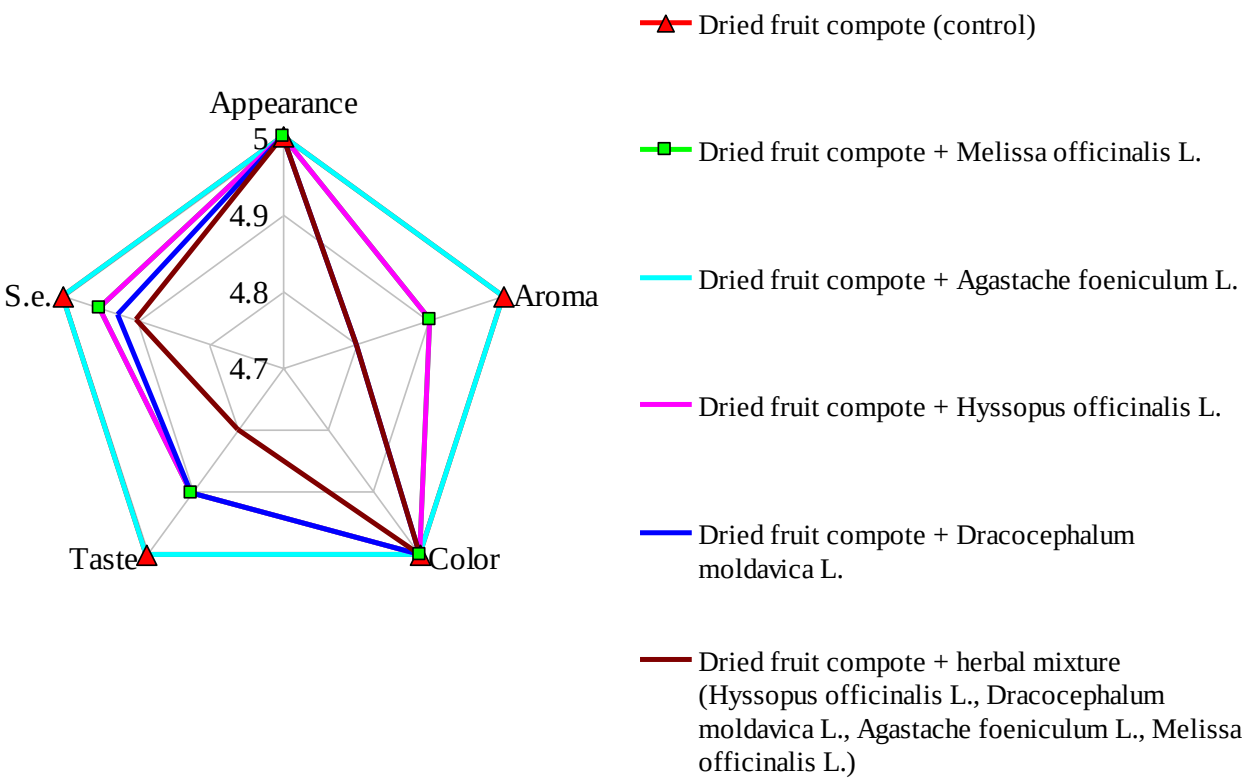


Figure 5. Sensory evaluation of dried fruit compotes

The data obtained are linked to fundamental scientific concepts related to the process of obtaining plant material shown in the work.

The study was conducted to improve restaurant technology by adding rare vegetables to restaurant dishes. This increases the antioxidant properties of innovative dishes, helps to strengthen the body's immunity, improves metabolism and has a beneficial effect on the cardiovascular system.

**Conclusions.**

1. Drying of spicy-aromatic plants in natural conditions causes preservation of only 20.3–33.7 % of total sugar and 0.8–4.4 % of ascorbic acid in the product.

2. Experimental studies have shown that all aromatic water-alcohol extracts contain antioxidant systems. All tested extracts were found to have positive recoveries ranging from (*RE*) 120.6 (*Agastache foeniculum L.*) to 250.2 mV (*Hyssopus officinalis L.*).

3. Improve the restaurant technology by adding spicy and fragrant raw materials,

which can increase the redox performance of the product, improve consumption performance, and reduce the cost of finished products.

4. The proposal regarding the use of uncommon types of vegetable plants in the restaurant technology in the production of tea-herb compositions, white and red main sauces, compotes in order to increase the biological value and improve the organoleptic properties is substantiated.