

THE INFLUENCE OF DIFFERENT TYPES OF BEEHIVES AND THE ORIGIN OF QUEENS ON THE QUALITY OF HONEY IN CROATIA

UTJECAJ RAZLIČITIH TIPOVA KOŠNICA I PODRIJETLA MATICA NA KAKVOĆU MEDA U HRVATSKOJ

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SUMMARY

Our research was aimed at determining the extent to which different types of beehives and the origin of queen-bees influence the quality of honey. We used three different types of hives that are most frequently used in beekeeping in Croatia. In each group there were 20 hives with queens of different origin, 10 natural queens, and 10 queens selected for honey production. All hives used were in the same location.

Based on the investigation of the influence of different types of hives (AŽ, DB and LR) and queens (natural and selected) we could conclude the following. Hive types had a statistically significant ($P < 0.05$) influence on the degree of acidity in honey (mmol acid/kg). The queen origin had a statistically significant ($P < 0.05$) influence on the activity of diastase. The interaction of investigated factors (hive types and queen origin) had an influence on the activity of diastase ($P < 0.001$), the water insoluble content ($P < 0.01$) and the thermal conductivity of honey ($P < 0.05$).

This paper also indicates that the anthropogenic (or human) factor, i.e. the creation of selected queen bees, can cause biological reactions, i.e. changes in the metabolism of individuals, different from reactions of individuals raised in nature.

Key words: Beehive, Queen-bee, Honey-full plants, Honey

INTRODUCTION

Our investigations were conducted in the Vukovar-Srijem county in Eastern Croatia. The investigations of plant species used as forage and the properties of honey from the area of the Vukovar-Srijem county in the years prior to this investigation were presented in the papers by Tucak *et al.* 1998, Tucak *et al.* 1999, Tucak *et al.* 2000. The influence of different types of hives on the quality of honey is presented in Tucak *et al.* 2004. In this

investigation our aim was to determine to what extent different hive types (AŽ, DB and LR) and origin of queens (natural and selected) influence the quality of honey.

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MATERIAL AND METHODS

We used three different hive types that are most frequently used in beekeeping in the Republic of Croatia, i.e. Albert-Žnidarsić (AŽ), Dadant-Blatt (DB) and Langstroth (LR), all made of lime wood. The AŽ hive, as well as LR and DB hives, has movable frames. The drawbacks of these hives are the impossibility of increasing its volume, and the small ventilation space. They are, therefore, not suitable for forage with a high daily input of nectar and pollen, as bees swarm more often and honey should be harvested more frequently.

In each group there were 20 hives with queens of different origin: AŽ-20, DB-20, and LR-20. In ten hives of each group there were 10 natural queens (reared by the bees themselves), and in the other ten there were 10 selected queens (reared by moving larvae from the maternal community to the brood), method by ("Jenter", Laidlaw (1956), Laidlaw and Page (1986)). All hives used in the investigation (60) were located at the same site during the entire investigation, and used the same forage. All honeybee broods used in the investigation belonged to the European *Apis mellifera carnica* race. The honey full pastures consisted of the following plants: Oil-seed Rape (*Brassica oleracea* subsp. *oleifera*), Lime-tree (*Tilia platyphyllos*), Horse-chestnut (*Aesculus hippocastanum*), Sunflower (*Helianthus*

annuus), False indigo (*Amorpha fruticosa*), False-acacia (*Robinia pseudacacia*), Goldenrod (*Solidago L.*) and other forest and meadow plants (Rinderer, 1982, Tucak *et al.* 1998, Tucak *et al.* 1999, Tucak *et al.* 2000).

Methods used in the honey analyses were as follows: 1) Water – refractometric analyses, 2) Analyses of the compounds insoluble in water – gravimetric method, 3) Analyses of the acidity – titrimetric method, applying the solution of 0,1 mmol/l NaOH, 4) Ash content analyses – measurement of the electrical conductivity using the conductometer, 5) Sugar content analyses – method according to Luff – school, 6) Sucrose content analyses – method according to Luff – school, 7) Analyses of the diastases activity, applying method of enzymatic hydrolyses of 1% starch solution from the 1 g of honey sample at temperature of 40 °C, during 1 hour, 8) Analyses of hydroxymethyl-puhrphurrol, photometric method at 550 nm according to Winkler.

The differences between the investigated factors (the influence of different hive types, different origin of queens, and the interaction between the hive types and different origins of queens) on the quality of honey were determined using the two-way ANOVA. Duncan's test was used to determine the differences between the investigated factors identified by ANOVA. Stastica for Win v.6.0 was used for data analysis.

RESULTS AND CONCLUSION

Table 1. Significance of F-test for all the main factors (beehive type, queen-bee lineage, and composition of honey) and interactions

Tablica 1. Statistička značajnost F-testa glavnih čimbenika (tip košnice, podrijetlo matice i sastav meda) i interakcija

Traits - Svojstva	Factors - Utjecaji		
	Beehive types Tipovi košnica	Queen-bee lineage Podrijetlo matice	Interactions between beehive types and queen-bee lineage Interakcije između tipova košnica i podrijetla matice
Water - Voda (%)	n.s.	n.s.	n.s.
Water insoluble compounds - Tvari netopive u vodi (%)	n.s.	n.s.	**
Acidity level (mmol of acid per kg) Stupanj kiselosti (mmol kiselosti po kg)	*	n.s.	n.s.

Traits - Svojstva	Factors - Utjecaji		
	Beehive types Tipovi košnica	Queen-bee lineage Podrijetlo matice	Interactions between beehive types and queen-bee lineage Interakcije između tipova košnica i podrijetla matice
Electrical conductivity, mS/cm Električna provodljivost, mS/cm	n.s.	n.s.	*
Reducing sugar - Reducirajući šećer (%)	n.s.	n.s.	n.s.
Sucrose content - Udio saharoze (%)	n.s.	n.s.	n.s.
Diastase activity, diastasic number Aktivnost dijastaze	n.s.	*	***
HMF, - mg/kg	n.s.	n.s.	n.s.

***=significant at $p<0,001$; ** =significant at $p<0,01$; * =significant at $p<0,05$; n.s.= not significant

***=značajno na razini $p<0,001$; **=značajno na razini $p<0,01$; *=značajno na razini $p<0,05$; n.s.=nije značajno

Table 2. Influence of interaction between beehive type and queen-bee lineage on the investigated characteristics of honey

Tablica 2. Utjecaj interakcije između tipa košnica i podrijetla matice na istraživana obilježja meda

Traits - Svojstva	Beehive types - Tip košnice						SE
	AŽ		DB		LR		
	Sel. (n=10)	Nat. (n=10)	Sel. (n=10)	Nat. (n=10)	Sel. (n=10)	Nat. (n=10)	
Water - Voda (%)	16,78	16,52	15,70	16,50	16,33	16,80	0,99
Water insoluble compounds (%) Tvari netopive u vodi (%)	0,010 ^b	0,007 ^b	0,024 ^a	0,007 ^b	0,011 ^b	0,023 ^a	0,0002
Acidity level, mmol of acid per kg Stupanj kiselosti (mmol kiselosti po kg)	12,51	13,10	14,50	18,83	18,15	17,19	30,15
Electrical conductivity, S/cm Električna provodljivost,	0,168 ^{bc}	0,160 ^c	0,161 ^c	0,228 ^a	0,211 ^{ab}	0,195 ^{ab}	0,003
Reducing sugar (%) Reducirajući šećer (%)	63,24	76,54	79,17	75,96	75,94	77,73	116,40
Sucrose content (%) Udio saharoze (%)	1,59	2,78	2,61	2,98	2,57	2,14	2,20
Diastase activity, diastasic number Aktivnost dijastaze	130,25 ^b	118,07 ^{bc}	77,74 ^c	173,74 ^a	135,87 ^{ab}	136,90 ^{ab}	2109,73
HMF, mg/kg	3,23	4,74	3,99	5,04	7,52	4,29	11,47

The values within same row marked with different letters (a, b, c) differ statistically significantly ($P<0.05$)

Vrijednosti u istom redu označene različitim slovima (a, b, c) razlikuju se statistički signifikantno ($P<0.05$)

Sel. – Selected/Selekcionirane

Nat. – Natural/Prirodne

SE – Standard error/Standardna greška

DISCUSSION

Our prior investigations showed that there was an influence of different types of hives on the quality of honey, Tucak *et al.* 2004. The hives had only natural queens. In this investigation we focused on the influence of natural and selected queens in different types of hives on the quality of honey. According to the regulations on the quality of honey and other bee products, the honey that will be on the market should meet these criteria:

The activity of diastase should not be below 8.0. The activity of diastase indicates the age and quality of honey.

Total acidity should not exceed 40 mmol of acid per kg; the acidity over 40 indicates the possible artificial production.

Electrical conductivity reflects the share of minerals in honey. The honey should not contain more than 0.6%.

The honey should not contain more than 0.1% of water insoluble compounds. The share of compounds insoluble in water indicates the quality and purity of honey.

In our research the different influence of the types of hives and queens (natural and selected) on the composition of honey (acidity, diastase, water insoluble compounds, and thermal conductivity) ranged between the values determined by the regulations, and warrants its regularity and use.

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SAŽETAK

Naša istraživanja imala su za cilj utvrditi u kojoj mjeri različiti tipovi košnica i podrijetlo matica utječu na kakvoću meda. U istraživanjima koristili smo tri različita tipa košnica koja se najčešće koriste u Hrvatskoj. U svakoj skupini određenog tipa bilo je dvadeset košnica različitog podrijetla matica, 10 prirodnih i 10 selekcioniranih za proizvodnju meda.

Istraživanja o utjecaju različitih tipova košnica (AŽ, DB, LR) i podrijetla matica (prirodne i selekcionirane) dala su sljedeće rezultate. Tipovi košnica imali su statistički značajan ($P < 0,05$) utjecaj na stupanj kiselosti meda (mmol acid/kg). Podrijetlo matica imalo je statistički značajan ($P < 0,05$) utjecaj na aktivnost diastaze. Interakcija istraživanih čimbenika (tipova košnica i podrijetla matica) imali su utjecaj na aktivnost diastaze ($P < 0,001$), sadržaj tvari netopljivih u vodi ($P < 0,01$) i toplinsku provodljivost meda ($P < 0,05$).

I ovaj rad je ukazao da antropogeni (ljudski) čimbenik (stvaranje selekcioniranih matica) može izazvati biološke reakcije (promjene u metabolizmu jedinki) različite od reakcija jedinki uzgojenih u prirodi.

Ključne riječi: košnice, matica, medonosno bilje, med