ECONOMIC BENEFITS ARISING FROM THE PREBIOTICALLY ENHANCED SUPPLEMENTARY FEEDING OF HONEYBEE COLONIES

SILVIA PĂTRUICĂ[1], MARIAN BURA[1], IOAN BĂNĂȚEAN DUNEA[2]

[1] Banat University of Agricultural Sciences and Veterinary Medicine, Faculty of Animal Science and Biotechnologies, Department of Animal Production Engineering, 119, Calea Aradului, 300645, Timisoara, Romania

[2] Banat University of Agricultural Sciences and Veterinary Medicine, Faculty of Agricultural Sciences, Department of Biology, 119, Calea Aradului, 300645, Timisoara, Romania.

Email: patruica_silvia@yahoo.com

ABSTRACT

Addition of prebiotic (acidifying) products to the supplementary feeds provided to honeybee colonies has a positive effect on colony health through favouring the development of a beneficial intestinal microflora. It also increases queen fecundity and oviposition leading to fast colony recruitment. We report the economic benefits of using acidifying substances (cider vinegar and lactic acid) in spring feeding supplements given to colonies. Trialling was conducted at Jebel, Romania between April 15 and May 4 2011 using 30 colonies which each received 1.4 l per week of supplemental feed sugar syrup with these substances added. Acacia honey production was assessed by weight at the end of May. Production was found to be significantly higher in the treatment group compared with the control ($p<0.05$) resulting, for the treatment group, in a predicted economic premium ranging between 9.38 and 22.06%.

Keywords: economic benefit, prebiotic products, honeybee colonies

INTRODUCTION

In order to maintain colonies in a biologically strong and productive condition the practice of beekeeping requires not only the availability of sufficient nectar and pollen resources during the entire foraging period but also the feeding of the bees during periods when natural resources do not suffice (BURA AND PĂTRUICĂ, 2003). Beekeepers' priorities are the maintenance of colony health and the provision of adequate pollen and nectar sources for their stocks.

The normal practice during periods of nectar shortage, if the beekeeper does not have a reserve of filled combs, is to provide a supplementary feed of sugar syrup (CHIRILĂ AND PĂTRUICĂ, 2005; MORARU, 2006).

Many researchers have reported benefits to colony health and development resulting from the incorporation of plant extracts in the supplementary syrup feeds. (BURA ET AL., 2004; PĂTRUICĂ ET AL., 2006; TOFALVI, 2009; PĂTRUICĂ ET AL., 2011).

POPOVICI (2011) found that addition of citric acid to protein-energy bee candy increased brood production in comparison with the control group. Similar results were found by PĂTRUICĂ ET AL. ($2011_{a, b}$) who doped sugar syrups with different dosages of lactic and acetic acids and cider vinegar.

This investigation aimed to establish whether, alongside these beneficial consequences for bee health, the addition of acidifiers (specifically lactic acid and cider vinegar) resulted in cost-effective economic benefits through greater honey production.

MATERIALS AND METHODS

30 colonies of honeybees (*Apis mellifera carpatica*) housed in multisection hives were studied, divided into three equal treatment groups of 10 colonies of comparable vigour and with queens of the same age.

Trialling was conducted at Jebel, Romania between April 15 and May 4 2011, with the colonies being fed sugar syrup incorporating, where appropriate, acidifiers (lactic acid or cider vinegar). Feeds were made up as shown in *Table 1.*

Table 1. Treatment regimes

No	Experimental variants	Food structure			
		Sugar syrup (ml)	pH of syrup	98% Lactic acid (ml)	Cider vinegar (ml)
1.	Control group (M)	1000	6.5	-	-
2.	Experimental group 1 (LE_1)	1000	4.2	1.5	
3.	Experimental group 2 (LE_2)	1000	5	-	12.5

Each colony was given, in feeders, a weekly supplement of 1.4 l syrup (1:1 sugar:water, 1kg sugar to 1 litre water) acidified as shown above. On May 10 the colonies were relocated for them to forage in the vicinity of rural acacia plantations. All colonies were maintained in multisection hives and given the same foraging opportunities. Statistical analysis was performed using the MINITAB 14 software package.

RESULTS

Honey production per colony is dependent on a number of factors: colony strength and health, the availability of nectar within bee flight range radius and meteorological factors (temperature, humidity and wind).

Evaluation of the effect of acidification of feed supplement on honey production was performed by weighing the quantities of honey accumulated by the colonies under study. This was done at the end of May.

Colonies fed syrup supplements acidified with lactic acid or cider vinegar produced between 15.5 kg and 19.1 kg of acacia honey (*table 2*).

Table 2. Production of acacia honey, statistical analysis

No	Experimental variants	Statistical parameters					Statistical significance
		n	$\bar{x}$	$S_{\bar{x}}$	S	CV	
1.	Control group (M)	10	15.5	±1.87	3.25	20.07	-
2.	Experimental group 1 (LE_1)	10	19.1	±2.32	5.04	18.98	*
3.	Experimental group 2 (LE_2)	10	16.9	±2.08	5.36	17.33	is

*$p<0.05$
is - insignificant

The data presented in table 2 show that the colonies fed with acidified syrup (lactic acid or cider vinegar) showed levels of honey production between 9.03% and 23.33% greater than the control group. It has been shown that acidification to a level of pH 4.2 had the best effect on colony development, these colonies producing between 900 and 5690 more brood

cells than experimental treatments fed syrup with a pH of 5-6.5 (PĂTRUICĂ ET AL., 2011_a). We can say that the feeding of colonies with the acidified syrups described stimulated egg deposition by the queen, thus allowing the colonies concerned to exploit the available acacia nectar better since they were able to deploy a larger number of foraging workers. Supplemental feed costs for the bee colonies over three weeks ranged between €2.9 and €4.3 per colony. The cost of prophylactic treatment against *Varroa destructor* mite was €1 per colony for all colonies studied and the cost of transport to the foraging area was €1.5 per colony. The labour, carried out by the beekeeper's family, involved an average of two hours per day. Acacia honey was sold for €3/kg.

Table 3.Economic benefits of the use of prebiotic products in the supplemental feed of bee colonies

No.	Specification	Experimental variants		
		Control group (M)	Experimental group 1 (LE_1)	Experimental group 2 (LE_2)
1	Cost of food supplement (€/colony)	2.90	4.30	3.10
2	Cost of treatment (€/colony)	1	1	1
3.	Cost of transport to field (€/colony)	1.5	1.5	1.5
4	Total cost (€/colony)	5.4	6.8	5.6
5	Income (€/colony	46.50	57.30	50.7
6	Profit (€/colony)	41.1	50.5	45.1
7	Profit (€/study group (10 colonies)	411	505	451

The use of acidifiers (lactic acid or cider vinegar) in the concentrations studied led to the obtaining of a profit 9.73% greater than the control group for the group fed syrup treated with cider vinegar, with a 22.87% enhancement of profit being registered for the group fed syrup treated with 1.5 ml 98% lactic acid *(figure 1)*.

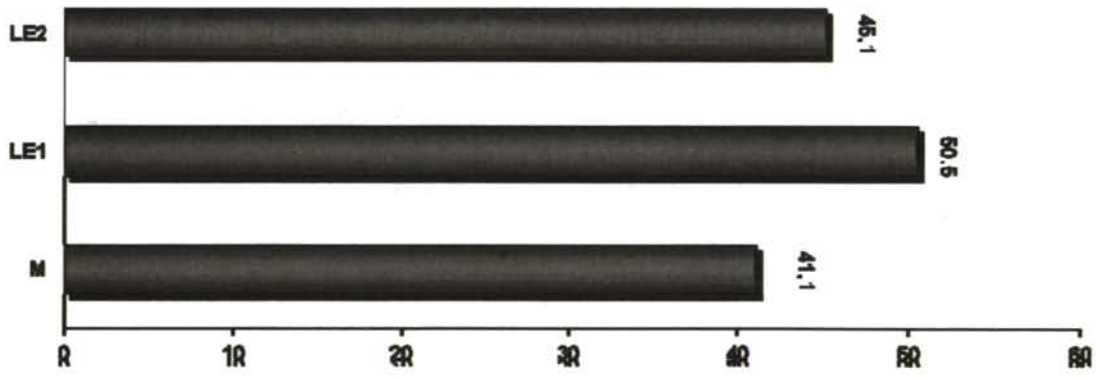

Figure 1 Profit/colony following feeding with acidified syrup supplements

CONCLUSIONS

1. The addition of acidifiers (lactic acid or cider vinegar) to supplementary feeds resulted in better colony growth (12.64% and 15.34% more brood production respectively, compared with the unacidified control). By the time the acacia nectar was ready for collecting these had developed into foraging workers.

2. Proceeds from the sale of the first take of honey were between 9.03% and 23.22% greater for colonies which had received acidified feed, with the best profit shown from colonies whose sugar syrup feed had been dosed with 1.5 ml lactic acid.
3. Total maintenance expenses for all the colonies studied were between 5.4 €/colony (LM) and 6.8 €/colony (LE_1), these costs including feed costs, two prophylactic treatments against *Varroa destructor* mites and colony transport costs to the foraging area.
4. The profit obtained following lactic acid or cider vinegar dosing of supplementary feed syrup was greater by between 9.73% and 22.87%. This allows us to recommend such treatment in the early spring after the cleaning flight.

ACKNOWLEDGEMENTS

This work was co-financed by the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/89/1.5/S/63258 "Postdoctoral school for zootechnical biodiversity and food biotechnology based on the eco-economy and the bio-economy required by eco-san-genesys".

REFERENCES

BURA M., PĂTRUICĂ SILVIA (2003) Nutriţia şi alimentaţia albinelor, Agroprint Press, Timisoara, pp 234.

CHIRILĂ AURELIA, PĂTRUICĂ SILVIA (2005) Tehnologii apicole moderne, stupărit pastoral, Fundaţia Naţională Satul Românesc Press, Bucureşti, pp 239.

BURA M, PĂTRUICĂ SILVIA, ONIŢA-CHIŞ D. (2004) Cercetări privind influenţa unor biostimulatori apicoli asupra sănătăţii şi dezvoltării puietului familiilor de albine în sezonul de primăvară, Simpozionul internaţional Apicultura în contextul noilor cerinţe europene, Timişoara, 88-100.

MORARU P. (2006) Nutriţia şi alimentaţia albinelor, Coral Sanivet Press, Bucureşti, pp 216.

PĂTRUICĂ S., BURA M., BĂNĂTEAN DUNEA I., POPESCU I., SIMIZ, E., SCHIOPESCU P. (2006) Research on the influence of some apiary biostimulators on the development of bee colonies salping in the autumn season, Scientifical papers Animal Science and Biotechonologies, Timisoara, 39, 117-123.

PĂTRUICĂ, S., BOGDAN, A.T, BURA, M., BĂNĂTEAN DUNEA, GÂLTOFET, M. (2011) Research on the effect of acidifying substances on bee colonies development and health in spring, Scientifical papers Animal Science and Biotechonologies, Timisoara. 44, 117-123.

PĂTRUICĂ, S., BOGDAN, A.T., BURA, M. POPOVICI, D. (2011) Research on the effect of acidifying substances on bee colonies development and health in spring (2), Agrobuletin AGIR. 2 (9), 124-130.

POPOVICI D. C. (2011) The influence of certain additives in the supplementary feeding of bee families, PhD Thesis, Timişoara, Romania.

TOFALVI MELINDA (2009) Biostimulating effect of some plant extracts upon bee families development, PhD Thesis, Cluj-Napoca, Romania.