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Improving Reproductive Qualities of Pigs Using the Drone Brood Homogenate

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Abstract

A nine- and ten-day drone brood was collected, homogenized, and stabilized in 70-degree alcohol. Conducted chemical analyses of the resulting extract revealed the presence of a number of biologically active substances, including sex hormones. Parenteral injection of the extract to junior boars increases the weight of the seminal glands by 20.1-21.9% and epididymis by 21.8-25.8%, as well as recovers sexual dysfunction of boars (83.3%). Administering extract to boars improves quantitative and qualitative indicators of breeder's semen productivity: ejaculate volume increases by 54.3%, germ cell density by 27.1%, survivability by 51.2%, and mobility by 14.2%. The number of damaged acrosomes in spermatozoon reduces by 2.1 times, and fertility of sows increases by 76.4%. Therefore, the extract can be used as a breeders' gonad protector.

Keywords

Drone; Homogenate; Boars; Hormones; Brood; Semen productivity; Conception rate

Introduction

Various anthropogenic processes lead to chronic stresses and disruption of metabolic processes in the boars' body. This results in refusing from tugging with sows or the output of defective ejaculates. Therefore, the issues on primary prevention and treatment of breeders' reproductive ability, combined with the impaired quality indicators of ejaculates, make the finding of a new effective means of animals' sexual activity extremely urgent.

At the end of the last century, apiculturists around the world began to study a homogeneous biomass of the drone-breeding larvae. Research has shown that it can serve as a source of protein, rich in essential amino acids, fats, and carbohydrates, as well as enzymes, sterols, vitamins, macro- and micro-elements, hormones, and unsaturated compounds (decenoic acids and sulfhydryl compounds) and other physiologically important components [1-5]. Also, it contains natural sex hormones, such as testosterone, progesterone, and estradiols.

Larvae of open drone brood accumulate considerable balanced nutrients reserve in a very short period of ontogenesis (5-6 days), allowing to form the imago from the ovule. This results in natural creation of animal and vegetable complexes of substances, namely bio based products, having certain physiological properties [6-8].

The purpose of the present research is to explore the feasibility of using the drone brood homogenate extract as stimulating, therapeutic, and preventive agent to develop boars' genital glands and recover impaired semen productivity of adult boars.

Materials and Methods

The Large White pigs and the drone brood of Carpathian bees, harvested at the bee yards of Southwest Kazakhstan, served a test material. The quality of boars' semen was determined by the standard technique [9,10].

Study of the chemical composition and properties of bees drone brood was performed in the accredited Regional Laboratory using

techniques [2] for the quality definition according to the following criteria: organoleptic evaluation, the number of natural hormones, and the content of sulfhydryl groups. The study of hormones in the alcohol extracts of the drone brood was conducted by radioimmune method using standard sets of "Immunotech" (Czech Republic) at the Radioisotope Laboratory of the Auezov University.

Preparation of alcohol extract of the drone brood was conducted by maceration technique during 10 days at a temperature of 20°C providing stirring 5-6 times a day. The drone brood aged 9-10 days was removed from the comb with tweezers, placed in vials of dark glass and charged by 70-degree medical ethanol. Extract consisted of 10% of homogenate and 90% of 70-degree alcohol. After a 10-day liquid infusion was decanted and the residue was squeezed and washed with the same liquid. Both liquids were mixed, defecated during 5 days and filtered at 8°C. Until application the extract was stored at -20°C during 6 months.

Results

In terms of organoleptic indicators, the homogenate, stabilized in an alcohol extract, is a transparent liquid with a light yellowish shade and spicy aroma. The authenticity of the product is certified by its chemical composition: the product contains the unsaturated fatty acids in terms of oxidability and content of decenoic acids in an alcohol extract (Table 1). Spectrophotometric studies of the extract have shown the presence of flavonoid compounds, producing on the animal's organism P-vitamin effect. Availability of decenoic acid (10-dihydroxydecenoic acid) is one of the main criteria of authenticity

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Indicators	Source brood	Homogenate extract (10% of homogenate + 90% of 70-degree alcohol)
Mass fraction of water (%)	79.32 ± 2.14	78.22 ± 2.91
Mass fraction of decenoic acids (%)	3.29 ± 0.06	2.64 ± 0.02
Mass fraction of flavonoid compounds (%)	0.014 ± 0.007	0.005 ± 0.0002
Concentration of hydrogen ions (Ph)	6.23 ± 0.32	6.41 ± 0.43
Oxidation rate	12.4 ± 0.51	64.97 ± 2.19
Crude protein (%)	41.78 ± 1.27	3.81 ± 0.08
Content of sulfhydryl groups (%)	297.53 ± 8.54	27.54 ± 1.42
Testosterone (nmol/l)	5.76 ± 0.72	0.051 ± 0.004
Progesterone (nmol/l)	84.39 ± 1.51	0.93 ± 0.03
Estradiol (nmol/l)	1196.57 ± 75.17	149.3 ± 4.94
Prolactin (nmol/l)	821.36 ± 8.56	7.43 ± 0.41
Cortisol (nmol/l)	349.34 ± 4.18	29.46 ± 1.25

Table 1: Chemical indicators of alcohol extracts of the drone brood

of the drone brood. Along with this, it was revealed that starting materials and the extract include crude protein, sulfhydryl groups, and sex hormones. Conservation of the drone brood in 10% alcoholic extract leads to a certain degree to the increase of the content of all biologically active substances from 9.1% to 19.76%.

It was ascertained that hormones, contained in the drone brood, pass to and are saved in alcoholic extracts, though in a slightly smaller amount.

In order to assess the prospects of using the drone brood as a source of stimulating, therapeutic and preventive agent, originally the effect of the drone brood homogenate extract on the development of genital organs was studied on 22 junior boars. It was revealed that the parenteral injection of the agent to the boars, aged 2-4 months, at a dose of 3 ml/10 kg once in 7 days, and to the boars aged 5-12 months at a dose of 4 ml/10 kg have a positive effect on the increase of the weight of the seminal glands and epididymis (Table 2). Weight of the seminal glands of boars aged 4-10 months was determined by measurements. Difference in the weight of seminal glands of the 4 months boars from control and experimental groups was 21.9%, while that of epididymis was 25.8%. Similar figures for the 12 months boars were 20.1% and 22.5%, respectively. The boars under test showed active movements, indicating the effect of the extract on actoprotective organs. Stimulating activity of genital organs due to application of homogenate extract was confirmed through control butchering of the boars.

The next series of experiments aimed at examination of the feasibility of using the drone brood homogenate extract as stimulating, therapeutic and preventive agent for adult boars with sexual dysfunction. Groups, each including 12 boars with sexual dysfunction were selected. Boars of experimental group were subjected to parenteral injection of 10 ml of the drone brood homogenate extract once a week for 2 months. After that, they were checked for semen quality. Within three weeks, boars showed increased palatability of feed and pronounced physical activity. The sexual activity of male pigs was assessed after 30 and 60 days. Observations have shown that 66.7% of male pigs in the control group retained refuse from tugging with sows even after a 2 month break. After injection of the drone brood homogenate extract, 33.3% of boars recovered their sexual function in 30 days, while 83.3% of breeders recovered in 2 months (Table 3).

Age of the boars	Seminal glands weight (g)		Epididymis weight (g)	
	Check experiment	Test	Check experiment	Test
2 months	33.9 ± 0.73	33.5 ± 0.78	4.6 ± 0.18	4.4 ± 0.16
4 months	132.8 ± 4.82	161.8 ± 5.48	20.9 ± 0.57	26.3 ± 0.88
6 months	448.7 ± 9.42	557.3 ± 14.77	–	–
8 months	609.8 ± 9.24	736.3 ± 22.61	–	–
10 months	802.3 ± 37.71	963.6 ± 39.76	166.5 ± 8.22	182.4 ± 14.62
12 months	997.1 ± 52.29	1198.3 ± 48.53	191.6 ± 9.74	234.8 ± 26.53

Table 2: Effect of the drone brood homogenate extract on the development of boars' reproductive system

Indicators	Control group (no homogenate extract used)	Experimental group (with the use of homogenate extract)
The number of boars with sexual dysfunction	6	6
Refuse from tugging during 30 days	5	4
Refuse from tugging during 60 days	4	1
Complete recovery of sexual function (%)	33.3	100.0
Ejaculate volume (ml)	186.3 ± 9.82	287.4 ± 11.68
Concentration of spermatozoon (mln/ml)	164.3 ± 9.9	208.8 ± 12.14
Absolute indicator of spermatozoon vitality (standard units)	7.8 ± 0.62	11.7 ± 0.96
Mobility of spermatozoon (score)	7.7 ± 0.81	8.8 ± 0.34
The number of abnormal spermatozoon (%)	29.4 ± 0.9	5.7 ± 0.38
Velocity of spermatozoon movement (µm/s)	21.6 ± 0.93	26.4 ± 0.85
Viability of structural SH-groups (%)	54.6 ± 1.24	67.2 ± 4.27
The number of damaged acrosomes (%)	12.9 ± 0.57	6.2 ± 0.23
LDH activity, µm of pyruvate per bln cells	6.6 ± 0.08	7.2 ± 0.68
The number of inseminated sows (heads)	17	17
Fertilized from one insemination	8	13
Fertilizing capacity (%)	47.0	76.4

Table 3: Effect of the drone brood homogenate extract on sexual activity and semen quality of adult boars

All qualitative indicators of ejaculates of boars from experimental group exceed those of animals from the control group: in the ejaculate volume – by 54.3%, and respectively, in spermatozoon concentration – by 27.1%; in absolute indicator of vitality – by 51.2%; in mobility – by 14.2%; in the spermatozoon velocity – by 22.2%; in viability of structural SH-groups – by 23.1%; in oxidation–reduction processes at respiration – by 9.1%; and in the number of damaged acrosomes – by 2.1 times. And most importantly, after the injection of the drone brood homogenate extract boars produced semen with normal fertilizing ability of spermatozoon. When inseminating the sows by semen of boars from the experimental group, fertility after the first insemination reached to 76.4%, which is higher than that for the boars from control group by 29.4%. These experiments show the complete rehabilitation of the animals with impaired sexual function. We have experimentally proved that the drone brood homogenate can be used as stimulating, therapeutic, and preventive agent at the dysfunction of spermatogenesis or other nervous stresses, leading to disruption of sexual reflexes. Apparently, the injection of extract having in its composition natural hormones, such as testosterone, progesterone, and estradiol, can have a stimulating effect on the animal endocrine system, restoring ovarian

function and metabolism in boars without disturbing the hormonal status of the animals.

Thus, the positive effect of the drone brood homogenate extract is manifested in increasing of the quantity, total weight, and normal spermatozoon, inherent to healthy animals, as well as production of high-quality ejaculates, which meet the requirements to semen quality for insemination of sows. The obtained results generally indicate the feasibility of using the drone brood homogenate extract as gonad protector.

Discussion

Works in Burmistrova, Lazarian, Connor [2,11,12] have shown that the drone brood is a “bank” of biologically active substances. According to Cruz-Landim and Barreto; Budnikov [13,14], the drone brood, due to its unique composition, has tonic effect on human and animal organism [15] as well as immunomodulatory effect. It enhances metabolic processes (Crane), restores the activity of the endocrine glands [16], increases resistance to infections [17], radiation and strenuous exercise. It is used successfully in the treatment of many diseases of bronchopulmonary and cardiovascular systems, as well as gastrointestinal tract.

We have revealed that administrating the drone brood homogenate extract to boars stimulates the central nervous system, providing a calming effect; this is consistent with the data of [18] obtained in humans. In our opinion, the therapeutic effect of the extract is based on the biologically active substances, contained in the drone larvae (Table 1). The same conclusion was made in Iliesiu [19], when examining the effect of the apilarnil-based drug; it is noted that it enhances the natural protective factors of organism.

Our study confirmed the findings of the above authors that brood contains sufficient amount of biologically active substances and natural hormones, which do not cause damage of the animals’ hormonal status. The drug has a stimulating effect on the endocrine system. It restores seminal glands function and metabolism of animals, promotes the accelerated development and revival of biochemical and mass-metric characteristics of the seminal glands, as well as is a promoting agent of the central regulation mechanisms in the androgens formation. It contributes to the recovery of anthropogenic sexual dysfunctions and increases sexual activity.

Conclusions

1. Obtained results demonstrate the feasibility of using the drone brood homogenate extract for animals as a gonad protector.
2. It is found that the parenteral injection of the drone brood homogenate extract to junior boars has a positive effect on increasing the weight of the seminal glands and epididymis. In terms of weight of genital organs, the difference between the boars from control and experimental groups aged 4 months was 21.9% for

seminal glands and 25.8% for epididymis; while for boars of 12 months these figures were 20.1% and 22.5%, respectively.

3. Within three weeks, boars showed increased palatability of feed and pronounced physical activity. At that 66.7% of male pigs in the control group retained refuse from tugging even after a 2 month break. After injection of the drone brood homogenate extract, 33.3% of boars recovered their sexual function in 30 days, while 83.3% of breeders recovered in 2 months.

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