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CHLORELLA SUSPENSION IN PIGS' RATIONS

Abstract

The article covers addition of chlorella suspension, its effect on nitrogen balance, digestibility of nutrients and amino acids, pig productivity.

Various feed additives, micro-element mixtures, and vitamins are used in animal nutrition to deal with the deficiency of certain vitamins and mineral elements in the rations.

The peculiarity of chlorella suspension as a feed additive is in the ability to cultivate it throughout the whole year and in the availability of optimized technologies for its cultivation and use. Chlorella suspension is rich in proteins, minerals, vitamins, fatty acids and fiber.

Introduction of chlorella suspension into pigs' diets has helped to increase the digestibility coefficients of both inessential (by 7.5 %) and essential (by 2 %) amino acids. Feeding the animals with chlorella suspension has also resulted in the release of nitrogen retained in animals' bodies by 13 % compared to the control group.

The additional use of chlorella suspension in the diet of fattening pigs (large white) was found to increase the average daily gain by 21.9% compared to the control group which did not receive chlorella suspension. The conversion of animal feed to obtain 1 kg of live weight gain in the control group was 5.1 kg, in the experimental group - 4.2 kg, and the conversion rate of feed in the experimental group was higher by 21.4 %.

Feeding young pigs with chlorella suspension increases the digestibility of protein by 4.5 %, fiber by 2.0 %, fat - 0.7 %, essential amino acids - 81.6 %.

The introduction of chlorella suspension to pig rations leads to an increase in the level of nitrogen in their body by 54.7 % of that taken with feed and 69.15 % of that digested in the body.

Pork production profitably using chlorella suspension stood at 12.3 %, which is more by 87,8 % compared to the control group.

Key words: chlorella suspension, digestibility of nutrients, average daily gains, feed costs per 1 kg of gain, profitability.

Introduction

Today, scientists and specialists in the pig industry all over the world are focused on finding the most efficient ways of use, which cover two-thirds of pork production costs.

The article presents study results of the effectiveness of chlorella suspension as a source rich in proteins, minerals, fatty acids and fiber. It contains many vitamins, polyphenols and other components that have a positive effect on animals' bodies.

The use of chlorella allows to ensure multifactorial ration balancing in accordance with modern feeding standards, thus raising the feed's productivity and significantly increasing the transformation of nutrients into livestock products.

In pork production, pig fattening determines production's quality and profitability.

The main goal of fattening is to provide a whole complex of nutrients and biologically active substances to achieve the maximum possible average daily gain, as well as to obtain a safe and biologically complete protein product.

Production practice shows that most animals grow much slower than they are physiologically capable to do. This is mainly due to the lack of biologically active substances in animals' rations.

With a shortage of biologically active substances in feeds, their number in livestock products decreases accordingly.

Consequently, the study of feed additives'

impact on animal productivity and quality of livestock products is of both theoretical and practical importance.

In the practice of feeding animals, various feed additives, mixtures of micro-elements and vitamins are used to cover the deficiency of certain vitamins and minerals in the ration.

That being said, most existing recipes for commercial and local feed additives have limited productive effect due to the fact that they do not take into account the actual zonal and local-economic, chemical (macro-micronutrient) composition of feeds, which does not fulfill the actual deficiency of macro and micro-elements in feeds and rations of a particular region or farm area to the level of requirements of modern animal nutrition standards.

When creating each new type of feed additive it is necessary to test its effectiveness in animal nutrition.

The advantages of this feed additive are in the ability to cultivate chlorella throughout the year, the availability of optimized technologies for its cultivation and use.

Chlorella is the simplest alga consisting of a single cell which contains a huge amount of nutrients and other trace elements necessary for a productive life of any organism. Chlorella itself is not a chemical and, in comparison with other biological additives, significantly beats any premix in all respects, as it is a living organism, namely the simplest unicellular alga.

Literary review

Scientists have come to a conclusion that the use



of monotonous feeds has a negative effect on productive resistance of animals, which leads to various pathologies, diseases, reduced productivity and efficiency of the whole industry [1]. It is expected that production and consumption of pork and poultry will increase by 70% in the 2000-2030 period, and by 120% in 2000-2050 respectively. [10]

It is a well-known aspect that a limiting factor in the development of pig and poultry industries is the inability of animals to quickly absorb nutrients concentrated in feed [1,4]. A complete ration for pig feeding has to include protein and a limited amount of fiber [2], as pigs have a single-chamber stomach which does not have the enzymatic ability to hydrolyze it [1,3].

Therefore, protein-vitamin supplements (PVS), veterinary drugs for prophylactic and therapeutic purposes, mainly antibiotics, probiotics, and feed additives of mineral origin are used in farm animals' diets. [5]

According to scientific studies, unbalanced rations and violations of sanitary standards of maintaining farm animals have caused changes in their gastrointestinal tracts, thus complicating the selection of the required drug [6]. Thereby, probiotics and prebiotics are widely used to solve these problems in pig and poultry industries [7].

Obtaining maximum productivity, reducing the cost of livestock products, and realizing the genetic potential of an animal's body is possible only using high-quality and full-fledged feeds that include various biologically active substances [1,9]

That is why balanced feeding is possible based on a natural plant - a new planktonic microscopic alga *Chlorella*, which has a very high biological value due to its composition [3].

The purpose and objectives of the study. The goal of this research is to study the effects of *chlorella*

Table 1 – Study scheme

Groups	Number of animals, cattle	Feeding type	
		Equalizing, 15 days	Main, 60 days
I - control group	12	Main ration (MR)	MR
II - experimental group	12	MR	MR+chlorella suspension (500 ml per day per head)

Table 2 – Balance experiment scheme

Experiment period	Number of animals, cattle	Duration of the preparatory period, days	Duration of the main period, days	Feeding conditions
control	4	3	8	Main ration (MR)
experimental	4	3	8	MR + chlorella suspension

suspension additives on nitrogen balance, digestibility of nutrients and amino acids, animal productivity.

Research materials and methods

Chemical composition studies of *chlorella* suspension were carried out at the "Soils Protection Institute of Ukraine" in Ovidiopol district, Odessa region, Zh/M "Chervonyi khutir".

Scientific research on the use of *chlorella* suspension (*Chlorella Vulgaris*) for fattening pigs was performed in DPDH "Iuzhnyy" ODSGDS NAAN.

Studies were conducted on two analogous groups of young pigs of large white breed with 12 cattle each (table 1). The equalization period consisted of 15 days, after which the animals of the second group received *chlorella* suspension in the amount of 500 ml per head per day. The first group was a control one and did not receive any supplements. The main period lasted 60 days.

The main ration in the equalization period consisted of: barley bran - 0.7 kg, corn bran - 0.5 kg, wheat bran - 0.4 kg, pea bran - 0.2 kg, grass meal - 0.2 kg, combined silage - 1.4 kg. The total nutritional value of the ration was 2.59 fodder units and 209.3 grams of digestible protein. As the experimental animals grew, the contents of individual feeds in the main ration were increased in accordance with recommended detailed standards. Only the basic diet for fattening pigs was applied in the control, whereas in the second experimental group *chlorella* suspension was added to watering according to the study scheme.

In order to study the effect of *chlorella* suspension on the digestibility of nutrients in the rations, scientific, economic, and balance experiments were conducted. The research was held on the basis of the «Iuzhnyy» research establishment in the Velykyi Dalnyk village, Biliaivskyi district, Odessa region.

For the balance experiment, 4 heads of young pigs of large white breed were selected taking sex, age, and live weight into account. The age of the experimental animals was 3-3.5 months, with the live weight average of 33.7 kg. The experiments were carried out by a method in accord with the following scheme (Table 2). The animals were kept in special individual spaces equipped to collect leftovers, feces, and urine.

During the preparation period, the pigs were fed the main ration mixture. During the study periods, *chlorella* suspension was additionally added to the main ration of the experimental group.

The digestibility of dietary nutrients, including amino acids and nitrogen balance, was studied on the basis of balance experiment. Contents of crude matter, protein, ash, fat, fiber and nitrogen-free extractives were determined in feed, feces and urine using generally accepted methods.

Determination of amino acid composition of feeds and metabolic products was performed by elemental ion exchange chromatography on automatic amino acid analyzers AAA-881 and "Amino chromium - II" produced in Czechoslovakia and Hungary.

**Table 3 – Digestibility of amino acids in experimental pigs, %, n = 4**

Amino acids	Groups	
	Control group	Experimental group
Essential amino acids		
Lysine	74,80 ± 0,31	74,90 ± 0,73
Histidine	82,90 ± 1,0	80,80 ± 1,2
Arginine	78,1 ± 1,4	78,0 ± 1,4
Threonine	64,20 ± 1,58	74,0 ± 3,34
Methionine	70,50 ± 4,01	78,0 ± 1,64
Valine	75,30 ± 0,92	75,5 ± 1,52
Phenylalanine	78,50 ± 1,72	87,0 ± 2,36
Isoleucine	73,00 ± 1,72	73,60 ± 2,03
Leucine	76,80 ± 2,34	74,0 ± 2,46
On average	74,90 ± 2,07	76,4 ± 1,46
Inessential amino acids		
Aspartic acid	78,5 ± 0,28	85,00 ± 2,17
Serine	78,60 ± 1,27	85,10 ± 3,0
Glycine	74,00 ± 0,94	76,00 ± 2,12
Glutamic acid	86,90 ± 1,75	91,5 ± 0,78
Alanine	68,40 ± 2,17	70,4 ± 0,52
Tyrosine	70,10 ± 3,2	82,00 ± 1,19
On average	75,9 ± 2,7	81,6

Research results

The chlorella suspension introduced into the rations of pigs increased digestibility coefficients of both essential (2%) and inessential (7.5%) amino acids. (Table 3).

The level of nitrogen assimilation in experimental pigs in connection with the addition of chlorella suspension to their ration was determined by analyzing their nitrogen balance (Table 4).

Feeding animals with chlorella suspension has led to an increase in nitrogen content in their body, by 14.5 % compared to the control group in the balance experiment.

Table 4 – The average daily nitrogen balance in experimental pigs, n = 4

Indicator	Group	
	control	experimental
Eaten, g	32,0 ±	34,9 ± 0,6
Released, g:		
with urine	8,4 ± 1,11	8,51 ± 1,1
Digested, g	25,0	27,6 ± 0,59
Remained in the body, g	16,6	19,09 ± 0,9
% of food eaten	51,8	54,7 ± 3,8
% of food digested	66,4	69.15 ± 4.5

Economic efficiency of the research results was calculated based on the obtained data. The cost per 1 kg of gain in fattening pigs using chlorella suspension was lower by 18 % compared to the control group, and the average daily gain in the experimental group was by 21.9 % higher than in the control group.

The use of chlorella suspension in pig rations positively affected gross profit, which amounted to 32,400 UAH in the experimental group; that is by 4.3 % more than in the control group. The profitability of pork production using chlorella suspension was 12.3 %. That is by 87.7 % more than in the control group. Therefore, it is economically feasible to use chlorella suspension in pig feeding.

Conclusions

The nutritional value of feed protein is determined by its presence and its ratio of essential amino acids. However, the use of pork protein is also affected by the proportion of inessential amino acids.

Feeding young pigs with chlorella suspension increases the digestibility of protein by 4.5 %, fiber by 2.0 %, fat - 0.7 %, essential amino acids - 81.6 %.

The introduction of chlorella suspension to pig rations leads to an increase in the level of nitrogen in their body by 54.7 % of that taken with feed and 69.15 % of that digested in the body.

The use of chlorella suspension in the rations of fattening pigs has a positive effect on their growth, which is characterized by the average daily growth of the experimental group, which was by 21.9 % higher than in the control group.

The profitability of pork production using chlorella suspension was 12.3 %, which is more than in the control group by 87.7 %.

REFERENCES

1. Bogdanov A. A. Aktual'nyye voprosy kormleniya sel'skokhozyaystvennykh zhivotnykh / G. A. Bogdanov, D. A. Mel'nichuk, I. I. Ibatulin (i drugiye) // Nauk. vestnik NAU. - 2004. - Vyp. 74. - s. 11-24. [In Ukraine].
2. Lyman' V. A. Progressivnyye tekhnologii v svinovodstve i ikh preimushchestva / A. Lyman', V. M. Voloshchuk, I. V. Khat'ko (i drugiye) // Svinarstvo Ukrainy. - 2012. - №7. - s. 6-7. [In Ukraine].
3. Bogdanov N. I. Khlorella: zelenyy korm kruglyy god. / N. I. Bogdanov // Kombikorma. №3 2004. - s. 66. [in Russian].
4. Svezhentsov A.I. Normirovannaya kormleniye sviney / A.I. Svezhentsov, R.Y. Portnykh, YA.I. Poltorak // L'vov.: LKT L'vovskaya natsional'naya akademiya veterinarnoy meditsiny imeni S.Z. Gzhitskogo. - 2005. - s. 385. [In Ukraine].



5. Kulikov V.M. Netraditsionnyye korma i ikh ispol'zovaniye / V.M. Kulikov // Optimizatsiya kormleniya zhivotnykh. - 1991. - s. 159-163. [in Russian].
6. Kalachnyuk I. Prirodnyye sorbenty v pitanii zhivotnykh / G. I. Kalachnyuk (i drugiye) // Zhivotnovodstvo. - 1997. - №8. - s.21-22. [In Ukraine].
7. Babich A.A. Kormovyye belkovyye resursy mira / A. Babich // Kiyev. -1995. - s. 186. [In Ukraine].
8. Gilbert R. Mirovoy rynek belka i kombikormov / R. Gilbert // Kombikorma. - 1999. - №3. - s. 15-17. [in Russian].
9. Stadtman E.R. Levine R.L. Free radical-mediated oxidation of free amino acids and amino acid residues in proteins // Amino acids. - 2003/-T.25- №3- 4. C.- 207-218.
10. Soya News: Feed Market News. <http://soyanews.info/>

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СУСПЕНЗІЯ ХЛОРЕЛИ В РАЦІОНАХ СВИНЕЙ

Анотація

Стаття присвячена вивченню впливу добавки суспензії хлорели на баланс азоту, перетравність поживних речовин та амінокислот, продуктивність свиней.

В годівлі тварин для покриття дефіциту окремих вітамінів, мінеральних елементів у раціонах використовують різні кормові добавки, суміші мікроелементів та вітамінів.

Особливість суспензії хлорели, як кормової добавки - можливість культивувати хлорелу на протязі всього року, наявність оптимізованих технологій її вирощування і використання. Суспензія хлорели багата на білки, мінерали, вітаміни, жирні кислоти та клітковину.

Введення до раціонів свиней суспензії хлорели сприяло підвищенню коефіцієнтів перетравності як замінних на 7,5% так і незамінних – 2% амінокислот. Згодовування тваринам суспензії хлорели призвело до звільнення утриманого в тілі тварин азоту на 13% порівняно з контрольною групою.

Встановлено, що додаткове використання суспензії хлорели у раціоні свиней на відгодівлі м'ясної породи (велика біла), сприяє підвищенню середньодобових приростів на 21,9% по відношенню до контрольної групи, яка не отримувала суспензії хлорели. Конверсія корму на отримання 1 кг приросту живої маси у тварин контрольної групи склала 5,1 кг, у дослідній – 4,2 кг, а коефіцієнт конверсії корму в дослідній групі був вище на 21,4%.

Рентабельність виробництва свинини з використанням суспензії хлорели становила 12,3% - це більше ніж у контрольній групі на 87,8%.

Ключові слова: суспензія хлорели, перетравність поживних речовин, середньодобові прирости, затрати корму на 1 кг приросту, рентабельність.

ЛІТЕРАТУРА

1. Богданов Г. О. Актуальні питання годівлі с.-г. тварин / Г. О. Богданов, Д. О. Мельничук, І. І. Ібатулін (та інші) // Наук. вісник НАУ. – 2004. – Вип. 74. – С. 11-24.
2. Лимар В. О. Прогресивні технології в свинарстві та їх переваги / В. О. Лимар, В. М. Волощук, І. В. Хатько (та інші) // Свинарство України. – 2012. - №7. – С. 6-7.
3. Богданов Н. І. Хлорелла: зелений корм круглий год. / Н. І. Богданов // Комбікорма. №3, 2004. – С. 66.
4. Свеженцов А.І. Нормована годівля свиней / А.І. Свеженцов, Р.Й. Кравців, Я.І. Півторак // Львів.: ЛКПТ Львівська національна академія ветеринарної медицини імені С.З. Гіжиського. - 2005. — С. 385.
5. Куликов В.М. Нетрадиционные корма и их использование/В.М. Куликов // Оптимизация кормления животных. — 1991. — С. 159–163.
6. Калачнюк Г.І. Природні сорбенти у живленні тварин / Г. І. Калачнюк (та інші) // Тваринництво. – 1997. - №8. – С.21-22.
7. Бабич А.О. Кормові білкові ресурси світу / А. О. Бабич // Київ. -1995. – С. 186.
8. Гилберт Р. Мировой рынок белка и комбикормов / Р. Гилберт // Комбикорма. - 1999. - №3. – С. 15-17.
9. Stadtman E.R. Levine R.L. Free radical-mediated oxidation of free amino acids and amino acid residues in proteins // Amino acids. - 2003/-T.25- №3- 4. - С. - 207-218.
10. Soya News: Новости рынка кормов. <http://soyanews.info/>

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