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Non-waste hydrobionts management

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ABSTRACT

The aim of the study was to investigate the possible use of mussels and algae wastes processed into high quality and safe food additives for the poultry. Black sea mussels (*Mytilus galloprovincialis* Lamarck) and algae (*phyllophora*) were used as a waste product. The samples were taken from the households where mussels were initially processed at an agar plant. Waste samples and derived additives were tested for bacterial load, quality and chemical composition. In addition, protein-mineral and mineral additive were produced from waste products. Their possible uses in poultry meat production were investigated. It was found that contamination with mesophilic bacteria and facultative anaerobic organisms fluctuates within current requirements. Sometimes even substantially exceeds them depending on waste storage conditions. The contamination with *E. coli*, *Salmonella*, and other pathogenic microorganisms is also observed within existing requirements or exceeding them. Chemical analysis reveal that intact mussels consist of average 80% wet matter and 20% dry matter, 9.4% protein, 1.2 % fat, 4.8 % nitrogen free extractive substances, 0.18% ash, 24.5 g/kg calcium, 1.0 g/kg phosphorus, 0.18 g/kg potassium. On the other hand, mussel valves consist of % 12 wet matters and % 88 dry matters, 37.2g/kg calcium, 0.2 g/kg phosphorus, 0.1 g/kg potassium. Use of additives in poultry production positively affects development and slaughter-out percentage and does not reduce the quality and biological value of their meat. As a conclusion it can be said that non-waste product from processed mussels represent a kind of raw material which can be used as food additive in animal industry after being technologically processed.

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INTRODUCTION

Ukraine is a maritime stat; it benefits from the bio resources of the black sea like other coastal countries. These bio resources contribute to the increase of food stuff, reduction of production costs and strengthening of the national economy (Kupynets, 1986; Amystyslavskyi, 1984]. One of the bio resources derived from the black sea is hydrobionts. The hydrobionts in the Black sea and its lagoons are one of the supplemental sources of food and feed protein. When used for food industry a lot of wastes are left causing environmental pollution. It is known that, wastes contain a certain amount of protein and mineral substances. Thus, researches conducted in this field showed, not only marine fish but also marine hydrobionts such as bivalve molluscs-mussels and algae are of great value.

Numerous studies by Odesa State Agrarian University researchers led by professor Kovbasenko found that mussels and algae (especially *Phyllophora nervosa*) are of great practical interest (among numerous bio resources of the sea) to agrarian production namely animal husbandry. If properly processed, they can be use as a protein and mineral sources for farm animals and poultry (Kovbasenko, 1993; Tarnazgenko, 2005; Kovbasenko, 2005).

The aim of the study was to investigate the possible use of mussels and phyllophora wastes processed into high quality and safe food additives for the poultry.

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Material and methods

Waste materials : The waste materials derived from the Black sea mussels were taken from a household where mussels were initially processed at an agar plant. Mussel's meat, valves and agar production waste (Algae after being processed into agar) were used as a material.

Waste samples and derived additives were tested for bacterial contamination (toxicity), quality and chemical properties.

Bacterial examination: Bacterial content of raw material for feed production is practically the main indicator of the possibility of use in fodder production. Bacterial contamination was studied using a microbiological method involving *Colpoda steinii* infusorium which was approved by the State Veterinary Medicine Department [Kovbasenko, and Melnyk, 2005; Kovbasenko, et al. 1982; Leonorm, 2000). The mesophilic aerobic and an optional anaerobic bacterial content of mussels should not exceed (CFU in 1 g) 5×10^4. The number of coliform (*E. coli*), golden staphylococci (*S. aureus*) and other pathogenic microorganisms does not exceed standards.

Qualitative assessment: For qualitative evaluation of the waste product, current state standards (which includes the rules of pre-slaughter veterinary and sanitary inspection of animals, meat and meat products) taken into account. In addition, pH of mussel's meat, reaction of mussels with sulfate, reaction of determination of amino-ammoniacal nitrogen and reaction on ammonia from reactive Nessler were performed.

Chemical properties: For the determined chemical composition of waste products moisture, dry substance, protein, fat, REM, ashes, calcium, phosphorus and potassium level were analyzed. In addition, magnesium, sodium, iron, manganese, zinc, copper, aluminum, molybdenum, nickel, iodine, silicon, barium, titan and cobalt were measured in the mussel's meat samples.

Production of protein-mineral and mineral feed additive: Protein-mineral additive was produced from only non-standard mussels and agar production wastes while mineral additive was produced from valves only (Kovbasenko and Dronova, 2008; Kovbasenko and Karaivan, 2009). To produce, mussels with no more than 40-45% of empty valves are mixed with agar production wastes in the ratio 5:1, crushed and hydrolyzed by hydrochloric acid. To produce mineral additive only valves are used being mixed with 10% of sea water, crushed and partially hydrolyzed by the acid. The paste gained after hydrolysis is mixed with 40% of decontaminated water and subjected to a short heat treatment. (15s, at 100℃).

Birds, feed and experimental groups: Totally 10 days old 240 ducklings were used in the study. The ducklings were divided into 2 groups as a protein mineral additive (PMA) and mineral additive (MA). Each consists of 3 subgroups (1 control, and 2 experimental groups). All bird had identical conditions and received the main staple ration, which was balanced by the basic specific substances in accordance with the applicable norms. Experimental groups and birds ration were presented Table 1. In accordance with the study methodology control and test groups of ducks were provided with staple ration for 8 days (aged from 12 to 20 days). From the 21st day till the end of the period (60 days in total) their ration was enriched by paste-like additives in the amount of 10% to the staple ration. We used the additives in 2 ways: 10% replacement of the staple ration with additives and adding extra 10% of additives to enrich the staple ration. At the end of the study birds were slaughtered and the meat quality was investigated.

Table 1: Research scheme

Feed additives	Study groups and ration	
	Comparative (12 – 20 days)	Basic (21 – 60 days)
Protein-mineral additive	PMA- control	SR - control
	PMA-I	90%SR+10% PMA
	PMA-II	100%SR+10% PMA
Mineral additive	MA-control	SR- control
	MA-I	90%SR+10% MA
	MA-II	100%SR+10% MA

SR= staple ration; **MA**= mineral additive; **PMA-I** = 90%SR+**10%** PMA ; **PMA-II**= 100%SR+**10%** PMA

Biological value of duck meat: Biological value of meat was defined on VASKhNIL methods (Lenin all-union Academy of Agricultural Sciences) using WH strain paramecium as the test object. Relative biological value (RBV) was defined on the scale for nominal product totaling to 100 per cent. RBV was calculated by the ratio of paramecia grown on experienced product multiplied by 100 or by the ratio of control product ABV (Absolute biological value) multiplied by 100.

The effects of feed additives from aquatic organisms on the biological value of broiler chicken meat in a complex way were studied: based on the amino acid composition of the protein, with the deduction of the protein quality index and the determination of biological value using the *Tetrachimena piriformis* infuzoria as a test object.

Results and discussion

According to the studies initial processing of mussels accumulates up to 70-80% of wastes: valves and small mussels polluting the environment. Without being disposed and properly treated they are left at fishing and initial processing positions. Most valves are intact of 4-6 cm with specific odor without sand or other impurities. The proportion of valve mass to mussel mass made up from 45 to 50%. Being processed, mussels result in smaller ones of not more than 3 cm. According to organoleptic characteristics small fresh mussels must have clean surface without sand or sludge, some of them having threads and intact valves. The valves are tightly closed releasing cloudy liquid when opened with an effort. Mussel body is moist and shiny firmly attached to the valves. The valves are closed tightly. Waste mussels have a typical subtle specific odor.

The researches on microbiological indicators of wastes according to the requirements of «Compulsory minimum list of researches on raw materials, vegetable and animal products, compound feedstuff, vitamin supplements etc.» found that contamination with mesophilic bacteria and facultative anaerobic organisms fluctuates within current requirements from $5×10^3$ and sometimes even substantially exceeds them depending on waste storage conditions. The insemination with bacteria of *E. coli*, *Salmonella*, and other pathogenic microorganisms is also observed within existing requirements or exceeding them. It was found that bacterial contamination of wastes depends on the fisheries, marine environment and freshness of wastes. As the toxicity tests of initially processed mussels showed, fresh and doubtfully fresh mussels satisfy the veterinary and sanitary requirements.

For a full assessment of initially processed mussels we determined their main chemical substances responsible for their fodder and biological values. Chemical composition of intact mussels and valves are presented in the Table 1. It was found that processed mussel wastes contain proteins and mineral substances which can be used as food additives but their content is not stable and depends on many factors (season, natural conditions, etc.). On average overall, wastes from processed mussels consist of raw material which can be used as food additive in animal feeds after being technologically processed.

Table 2: Chemical composition of intact mussels and valves

Chemical composition	Moisture content			
	Intact mussels		Valves	
	Variation rate	Average rate	Variation rate	Average rate
Wet matter (%)	74.2 – 86.4	80.0	9.8- 12.6	12.0
Dry matter (%)	25.8 – 13.6	20.0	90.2 – 87.4	88.0
Protein (%)	8.7 – 10.6	9.4	-	-
Fat (%)	0.7 – 1.6	1.2	-	-
NFES (%)	4.2 – 5.4	4.8	-	-
Ash (%)	0.16 – 0.2	0.18	0.78 – 0.92	0.90
Calcium (g/kg)	22.1 – 26.3	24.5	32.4 – 38.6	37.2
Phosphorus (g/kg)	0.9 – 1.2	1.0	0.18 – 0.23	0.2
Potassium (g/kg)	0.18 – 0.19	0.18	0.1 – 0.03	0.1

NFES –nitrogen-free extractive substances

Table 3. Impact of protein-mineral hydrobiont additive (PMA) on broiler ducks productivity (n = 40).

Production parameters	Control	PMA-I	PMA-II
Initial live body weight (g)	510 ± 1.6	508 ± 2.4	504 ± 1.2
Final live body weight (g)	2290 ± 2.34	2300 ± 3.26	2450 ± 2.3
Live body weight gain (g)	1780 ±3.62	1792 ± 4.12	1946 ± 4.21
Survival rate (%)	92.6	95.4	98.2

SR= staple ration; **MA**= mineral additive; **PMA-I** = 90% SR+**10%** PMA ; **PMA-II**= 100% SR+**10%** PMA

Both food additives represent grayish suspension with specific smell typical of mussels. Produced on the proposed technology food additives basically contain a complex of mineral substances essential for animals but at the same time protein-mineral additive is also a source of protein in the amount from 8.2 to 9.1%. As regards health, food additives produced according to the proposed technologies satisfy veterinary and sanitary requirements of current standards.

The effects of protein-mineral additives (PMA) on production performance of duckling are presented in Table 3. It was found that PMA addition increased live body weight gain approximately 6.8-9.32 % in PMA-I and PMA-II groups respectively. In addition, survival rate (conversation rate) was increased 2.8% and 5.6% in PMA-I and PMA-II groups respectively. Therefore, it can be say that, using protein-mineral hydrobiont additives has a positive effect on broiler ducks growth regardless the way used.

The effects of -mineral additives (MA) on production performance of ducks are presented in Table 3. The data indicated that body weight gain and relative growth rate do not differ from those in the control group in MA-I group. Therefore, it can be say that, replacement of the ration with 10% mineral additive does not have a significant impact on growth and development of ducks. But adding extra 10% of mineral to the ration increases the body weight gain by 1.73 % compared to the control group. The survival rate is also increased by 3.9% in this group.

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Biological value of duck meat is presented in Table 5. Meat quality parameters showed that, using food additives from hydrobionts doesn't affect qualitative and quantitative composition of ducks meat and using hydrobiont food supplements does not reduce biological value of meat.

It can be clearly seen from the given results that the use of hydrobiont food additives when feeding broilers following our method does not reduce the quality or biological value of their meat. In the overall, it must be noted that in modern conditions when catching and initially processing mussels up to 80% of wastes accumulate without utilization. It leads to environmental pollution at fishing and initial processing areas. It was revealed that these wastes can be used for food additives production for animals and birds. Our food additives produced from wastes are being successfully used in poultry production.

Table 4: Impact of mineral hydrobiont additive on ducks productivity (n = 40)

Production parameters	Control	MA-I	MA-I
Initial body weight, g	502±1,21	504±3,26	505±1,36
Final body weight	2292±2,12	2286±3,24	2406±2,24
Body weight gain, g	1790±3,69	1782±1,12	1821±2,32
Daily body weight gain, g	44,7±0,6	44,5±0,3	45,5
Relative growth rate, g	127,0	126,4	129,2
Survival rate (%)	93,4	93,6	97,3

SR= staple ration; **MA**= mineral additive; **MA-I** = 90%SR+**10%** MA ; **MA-II**= 100%SR+**10%** PMA

Table 5: Biological value of meat for both control and test groups (n = 5)

Indicators	Content in groups in %		
	Control group	Test group 1	Test group 2
ABV	45.8 ± 0.2	45.6 ± 0.2	45.8 ± 0.3
RBV	69.9 ± 0.3	69.9 ± 0.3	70.0 ± 0.4
CBV	100.0	101.2	101.6

ABV = absolute biological value; **RBV**= relative biological value; **CBV** = comparative biological value

Conclusions

Due to their chemical composition and biological value marine mussel's wastes can be used as raw material to produce food additives for animals.

A simple waste management technology was designed to initially process mussels into fodder additives: protein-mineral additive and mineral one.

Use of additives in poultry production positively affects development and slaughter-out percentage and does not reduce the quality and biological value of their meat.

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