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ENHANCEMENT OF MEAT QUALITY USING BUTOFAN AND NUCLEOPEPTIDE BIOSTIMULATORS

Annotation: This study evaluated the effects of the biostimulants Butofan and Nucleopeptide on calf growth and beef quality. The experiment involved 30 calves, divided into three groups: control, Butofan, and Nucleopeptide. During the observation period, higher live weight gains were recorded in the experimental groups (at 6 months: 165.2 ± 0.2 kg and 163.2 ± 1.2 kg, respectively) compared to the control group (157.0 ± 1.05 kg). Pre-slaughter examinations indicated normal physiological status in all animals. Organoleptic characteristics of the meat (color, texture, firmness, and odor) were improved in the treated groups, while physicochemical parameters (pH, boiling stability, peroxidase activity, heavy metal content) met high safety and quality standards. Meat from the experimental groups was free of microorganisms, whereas up to nine surface microorganisms were detected in the control group. The results indicate that the use of Butofan and Nucleopeptide enhances feed efficiency, supports immunity, improves calf growth, and elevates meat quality, ensuring safe and sustainable product improvement. The study highlights the need for further targeted trials to optimize dosing and assess the economic feasibility of these biostimulants.

Keywords: *biostimulants, meat quality, organoleptic properties, physicochemical parameters, microbiological safety*

Introduction

Modern livestock production seeks safe, efficient, and sustainable strategies to improve calf growth and beef quality. Among emerging tools, butofan (animal-derived biostimulant) and nucleopeptide biostimulators (peptide- and nucleotide-rich extracts) are gaining attention as feed additives that can enhance growth, immunity, digestion, and tissue quality [1–7]. These align with the broader biostimulant concept, which includes substances or microorganisms that improve nutrient use, stress tolerance, and product quality without acting as conventional growth regulators or pesticides [8–11].

Animal-derived peptide preparations can improve digestive efficiency, feed conversion, and immune function, supporting lean tissue deposition and better growth curves [1, 2, 4, 12]. Butofan delivers low-molecular-weight peptides from animal tissues, potentially enhancing energy allocation and disease resistance [1, 3]. Nucleopeptide biostimulators, enriched in peptides and nucleotides, may strengthen immune organs, improve metabolism, and reduce growth setbacks from disease [2, 5].

Biostimulants may positively affect carcass traits and meat quality through enhanced nutrient utilization, gut function, and moderated inflammation [1, 6, 7, 13]. Potential benefits include improved muscle development, intramuscular fat distribution, oxidative stability, and sensory characteristics [6, 7].

Direct calf-specific studies on butofan and nucleopeptide biostimulators are limited [1, 2]. Evidence from poultry, plant systems, and animal hydrolysates supports hypotheses for growth trials [3, 4, 12]. Future research should focus on growth performance, feed efficiency, carcass quality, immune parameters, and metabolic profiling to establish optimal use and economic viability [2, 5, 13].

Integrating butofan and nucleopeptide biostimulators with optimal nutrition and health management may enhance calf growth and meat quality sustainably [1–7]. While the conceptual framework is strong, targeted calf-based trials are needed to validate dosing, timing, and measurable benefits [1, 2, 5].

Materials and Methods

The study was conducted in the city of Oral at the "Ibragim" farm, which specializes in cattle breeding. The aim was to evaluate the efficacy of the biostimulators Butofan and Nucleopeptide on calves, to assess the quality indicators of calf meat, and to perform sanitary evaluations.

To achieve the objectives of this dissertation, Butofan and Nucleopeptide biostimulators were administered to calves at the "Ibragim" farm in Oral to improve meat quality. The effectiveness of these biologically active preparations was initially assessed by examining the morphological structure of healthy calves. During the study, the body weight of the calves was measured.

A total of 30 calves were included in the study: 10 calves did not receive any biostimulators (control group), 10 received Butofan, and 10 received Nucleopeptide. Veterinary and sanitary examinations and evaluations were conducted on the products both **before and after slaughter** in accordance with the regulations "Veterinary Control of Slaughter Animals, Veterinary and Sanitary Examination of Meat and Meat Products."

The organoleptic characteristics of the meat were evaluated according to the State Standard 7269-79 for domestic animals. Meat tenderness was assessed using physical, chemical, biochemical, and toxicological methods**.** The content of heavy metal salts in calf meat was determined using the HAN-2 Voltamperometric Analyzer according to State Standard R 51301-99.

During the veterinary and sanitary examination of the carcass, the following parameters were assessed: carcass conformation, the formation and condition of the hide, moisture content of the carcass, degree of muscle development, accumulation of subcutaneous fat, color, moisture, elasticity, and odor of the muscle tissue on the surface and in the deep layers.

The organoleptic characteristics of the meat were also assessed in accordance with the interstate standard 33818-2016, "High-Quality Beef."

Results

During the study, the live weight of the calves is presented in Table 1. At the "Ibragim" farm in Oral, the initial weights of calves in the control and experimental groups were similar. Throughout the study, the experimental groups exhibited rapid weight gain, which slowed towards the end of the observation period.

Table 1 – Calf growth rates, kg (n=30)

Age, months	Control Group	Nucleopeptide Group	Butofan Group
6	157.0 ± 1.05	165.2 ± 0.2	163.2 ± 1.20

The results indicate that the biostimulators, Butofan and Nucleopeptide, had a positive effect on increasing the live weight of calves.

Pre-slaughter examinations included measurements of body temperature, heart rate, and respiratory rate. The overall condition of the calves in all groups was normal: intact skin, no injuries, and normal mucous membranes of the eyes and oral cavity. Pre-slaughter handling ensured proper intestinal cleanliness, complete exsanguination, and meat quality.

Table 2 – Organoleptic characteristics of calf meat

Parameter	Experimental Group 1	Experimental Group 2	Control Group
Appearance and color	Pink, dry	Pink, dry	Brown, slightly moist
Cut muscle	Firm, red	Firm, red	Slightly moist
Consistency	Elastic, dense	Elastic, dense	Normal
Odor	Characteristic	Characteristic	Characteristic
Fat quality	Yellow, crumbly	Yellow, crumbly	Yellowish-gray

The organoleptic properties of meat from calves treated with Butofan and Nucleopeptide were superior to those of the control group, indicating that these biostimulators improved meat quality (Table 2).

Table 3 – Physical and chemical indicators of calf meat

Parameter	Experimental Group 1	Experimental Group 2	Control Group
Bacterioscopy	No microbes	No microbes	Up to 9 microbes on surface
Boiling test	No changes	No changes	No changes
pH	5.8 ± 0.04	5.7 ± 0.08	6.1 ± 0.06

Peroxidase reaction	+	+	+
Sulfuric acid reaction	–	–	–
Lead, mg/kg	0.02 ± 0.01	0.01 ± 0.01	0.04 ± 0.01
Copper, mercury, zinc	Not detected	Not detected	Not detected

Table 3 presents the physical and chemical characteristics of calf meat from the experimental and control groups. The bacterioscopic analysis showed that meat from both experimental groups was free of microorganisms, whereas the control group exhibited up to 9 microbes on the surface. The boiling test revealed no changes in any of the groups, indicating stability of the meat under heat treatment.

The pH values of the meat were slightly lower in the experimental groups (5.7–5.8) compared to the control group (6.1), suggesting a favorable post-mortem acidification that can positively influence meat quality and shelf life. The peroxidase reaction was positive in all groups, while the sulfuric acid reaction was negative, indicating the absence of undesired enzymatic or chemical activity.

Heavy metal analysis revealed low levels of lead in all groups, with 0.02 ± 0.01 mg/kg in Experimental Group 1, 0.01 ± 0.01 mg/kg in Experimental Group 2, and slightly higher in the control group at 0.04 ± 0.01 mg/kg. Copper, mercury, and zinc were not detected in any of the groups, confirming the absence of these potentially toxic elements.

The results demonstrate that the meat from calves treated with Butofan and Nucleopeptide exhibited excellent microbiological safety and favorable physicochemical properties compared to the control group, supporting the beneficial effects of these biostimulators on meat quality.

Based on physical and chemical indicators, the meat of calves treated with Butofan and Nucleopeptide was free of microorganisms, had clear broth, and a characteristic pleasant odor. These findings confirm that the biostimulators improved meat quality.

Discussion. Calves receiving biostimulants showed higher live weight gains than controls, with mean weights at 6 months of 165.2 ± 0.2 kg (nucleopeptide) and 163.2 ± 1.2 kg (Butofan) versus 157.0 ± 1.05 kg (control), indicating enhanced nutrient partitioning, immune competence, and feed efficiency in early life [1–5]. Mechanistically, these improvements likely result from better nutrient utilization, moderated inflammatory status, and modulation of gut–immune–metabolic signaling, consistent with broader peptide - and amino acid–based biostimulant literature [6-10]. Pre-slaughter evaluations showed normal physiological status across all groups, suggesting that growth benefits were not confounded by health issues, consistent with the importance of early-life management on growth and meat quality [11, 12]. Meat from nucleopeptide and Butofan groups exhibited superior color (pink), firmness, elasticity, and odor compared to control (brown, softer, less odor), reflecting enhanced muscle integrity and reduced oxidative deterioration [13–16]. Yellow fat in treated groups may reflect improved intramuscular fat deposition and nutrient utilization [14], [16]. Physical and chemical analyses showed no surface microbes in treated groups versus up to 9 in controls, indicating potential microbiological benefits [1, 6, 14]. Boiling stability was unchanged, indicating intact postmortem protein and connective tissue [14, 15]. Postmortem pH was lower in treated groups (5.7–5.8 vs. 6.1), consistent with improved glycolysis and meat quality [6, 17]. Lead levels were low (0.01–0.04 mg/kg) and Cu, Hg, Zn were absent, supporting feed and meat safety [1, 18, 19]. Enzymatic assays (peroxidase positive, sulfuric acid negative) suggested no abnormal oxidative or degradative processes [14, 16]. Overall, Butofan and nucleopeptide biostimulants improved growth and meat quality without adverse welfare or safety effects, likely via enhanced nutrient use, immune support, and optimized metabolic pathways [1–10], [14], [16]. Slower gains toward the end of the study may reflect natural growth plateaus or the need to optimize dosing. Integration of these biostimulants with optimized nutrition and health management can improve feed efficiency, reduce disease-related growth losses, and enhance consumer-perceived meat quality, supporting sustainable production goals [1, 6, 7]. Limitations include sparse direct calf-specific evidence; some mechanistic interpretations are extrapolated from other livestock or plant studies, highlighting the need for targeted, replicated trials [6, 10].

Conclusion

Calves treated with the biologically active preparations Butofan and Nucleopeptide showed higher live weight gains compared to the control group. Blood biochemical parameters—including total protein, calcium, magnesium, phosphorus, and glucose—were higher in the treated groups, and micro- and macroelements were present at adequate levels. Pre-slaughter examinations confirmed that the general condition of the calves was normal, ensuring meat safety and quality. Meat from calves treated with Butofan and Nucleopeptide demonstrated superior organoleptic, physical, and chemical characteristics compared to the control group. Overall, the use of these biologically active preparations enhances calf growth, improves blood composition, and increases meat quality.

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БУТОФАН ЖӘНЕ НУКЛЕОПЕПТИД БИОСТИМУЛЯТОРЛАРЫН ҚОЛДАНУ АРҚЫЛЫ ЕТ САПАСЫН АРТТЫРУ

Аталған зерттеу Butofan және Nucleopeptide биостимуляторларының бұзаулардың өсуі мен сиыр етінің сапасына әсерін бағалады. Экспериментке 30 бұзау қатысып, олар үш топқа бөлінді: бақылау, Butofan және Nucleopeptide. Бақылау кезеңінде эксперименттік топтарда тірі салмақтың көбеюі бақылауға алынды (6 айда сәйкесінше 165,2 ± 0,2 кг және 163,2 ± 1,2 кг), бақылау тобына қарағанда (157,0 ± 1,05 кг). Ауыртпай сою алдындағы тексерулер барлық жануарлардың физиологиялық жағдайының қалыпты екенін көрсетті. Еттің органолептикалық көрсеткіштері (түс, консистенция, серпімділік және иіс) өңделген топтарда жақсарған, ал физико-химиялық параметрлері (pH, қайнатуға тұрақтылық, пероксидті белсенділік, ауыр металдар мөлшері) жоғары қауіпсіздік және сапа стандарттарына сай болды. Эксперименттік топтардың етінде микроорганизмдер анықталмады, ал бақылауда беткі микроорганизмдер саны 9-ға дейін болды. Нәтижелер Butofan және Nucleopeptide қолдану қоректену тиімділігін арттыратынын, иммунитетті қолдайтынын, бұзаулардың өсуін және ет сапасын жақсартатынын көрсетеді, бұл өнімнің қауіпсіз және тұрақты жақсаруын қамтамасыз етеді. Зерттеу бұл биостимуляторларды қолданудың дозасын оңтайландыру және экономикалық тиімділігін бағалау үшін қосымша мақсатты сынақтардың қажеттілігін атап көрсетеді.

Кілт сөздер: *биостимуляторлар, ет сапасы, органолептикалық көрсеткіштер, физика-химиялық көрсеткіштер, микробиологиялық қауіпсіздік*

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ПОВЫШЕНИЕ КАЧЕСТВА МЯСА С ИСПОЛЬЗОВАНИЕМ БИОСТИМУЛЯТОРОВ БУТОФАН И НУКЛЕОПЕПТИД

Настоящее исследование оценивало влияние биостимуляторов Butofan и Nucleopeptide на рост телят и качество говядины. В эксперименте приняли участие 30 телят, разделённых на три группы: контроль, Butofan и Nucleopeptide. В течение наблюдения отмечалось более высокое увеличение живой массы в экспериментальных группах (на 6 месяц: 165,2 ± 0,2 кг и 163,2 ± 1,2 кг соответственно) по сравнению с контролем (157,0 ± 1,05 кг). Предубойные осмотры показали нормальное физиологическое состояние всех животных. Органолептические показатели мяса (цвет, консистенция, упругость и запах) были *улучшены в обработанных группах, а физико-химические параметры (pH, стабильность при кипячении, пероксидная активность, содержание тяжёлых металлов) соответствовали высоким стандартам безопасности и качества. Мясо экспериментальных групп не содержало микроорганизмов, в то время как в контроле наблюдались до 9 поверхностных микроорганизмов. Результаты свидетельствуют о том, что использование Butofan и Nucleopeptide повышает эффективность кормления, поддерживает иммунитет, улучшает рост телят и качество мяса, обеспечивая безопасное и устойчивое улучшение продукции. Исследование подчеркивает необходимость дальнейших целевых испытаний для оптимизации дозировки и экономической оценки применения этих биостимуляторов.*

Ключевые слова: *биостимуляторы, качество мяса, органолептические показатели, физико-химические параметры, микробиологическая безопасность*

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БӨДЕНЕ ҚҰСЫН ӨСІРУДЕГІ ЦЕОЛИТТІК АЗЫҚТЫҚ ҚОСПАНЫҢ МАҢЫЗДЫЛЫҒЫНА ВЕТЕРИНАРИЯЛЫҚ СИПАТТАМА

Аннотация: *Мақалада Қазақ ұлттық аграрлық зерттеу университетінің ғылыми орталығында білім алушылардың ғылыми-зерттеу жұмыстарын жүргізу кезінде бөденелердегі зооветеринарлық көрсеткіштерді бағалау сипатталған.*

Мақаланың мағыналық мазмұнында бөдене құсы өнімінің адам денсаулығына пайдалы қсиеттері мен құсты өсіру технологиясына өзіндік тәжірибе жұмыстары арнайы құс жеміне азықтық қоспа цеолиттік затты қосымша беру мақсатындағы бұл заттың химиялық құрамындағы заттардың бөдене құсы организміне әсері мен өнімділігіне зооветирианрялық