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TECHNOLOGY OF DEVELOPING STRENGTH QUALITIES IN STUDENTS USING BIOLOGICALLY ACTIVE SUPPLEMENTS

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Annotation

This study examines the technology of developing strength qualities in students through the use of biologically active supplements (BAS). The research highlights the importance of strength development as a fundamental component of physical training and emphasizes the functional role of BAS in enhancing muscular performance, recovery, and adaptation. Experimental methods were applied to evaluate the effectiveness of training programs combined with selected supplements. The findings demonstrate that properly administered BAS, when integrated with systematic strength training, significantly improve students' muscular strength indicators. The study offers practical recommendations for optimizing training programs and ensuring safe supplement use in educational settings.

Keywords

strength qualities; training technology; biologically active supplements; student fitness; muscular development; sports nutrition.

BIOLOGIK FAOL QO'SHIMCHALAR YORDAMIDA TALABALAR KUCH SIFATINI RIVOJLANTIRISH TEXNOLOGIYASI

Annotatsiya

Ushbu tadqiqot biologik faol qo'shimchalar yordamida talabalar kuch sifatini rivojlantirish texnologiyasini o'rganishga bag'ishlangan. Kuch sifatlari jismoniy tayyorgarlikning asosiy tarkibiy qismi sifatida talabalarning funksional imkoniyatlari va mushak kuchini oshirishda muhim ahamiyatga ega. Tadqiqotda biologik faol qo'shimchalarning mushak faoliyati, tiklanish jarayonlari va moslashuv mexanizmlariga ta'siri eksperimental usullar yordamida baholandi. Natijalar shuni ko'rsatdiki, muntazam kuch mashg'ulotlari bilan to'g'ri tanlangan qo'shimchalarni qo'llash talabalarning mushak kuchi ko'rsatkichlarini sezilarli darajada oshiradi. Tadqiqot yakunida ta'lim jarayonida qo'shimchalarni xavfsiz va samarali qo'llash bo'yicha amaliy tavsiyalar ishlab chiqildi.

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Kalit so‘zlar

kuch sifatlari; biologik faol qo‘shimchalar; mashg‘ulot texnologiyasi; talaba jismoniy tayyorgarligi; mushak kuchi; sport oziqlanishi

ТЕХНОЛОГИЯ РАЗВИТИЯ СИЛОВЫХ КАЧЕСТВ СТУДЕНТОВ С ИСПОЛЬЗОВАНИЕМ БИОЛОГИЧЕСКИ АКТИВНЫХ ДОБАВОК

Аннотация

В данном исследовании рассматривается технология развития силовых качеств студентов посредством использования биологически активных добавок (БАД). Силовые качества являются важнейшим компонентом физической подготовки и играют ключевую роль в повышении мышечной работоспособности, адаптации и восстановлении. Экспериментальные методы позволили оценить эффективность тренировочных программ в сочетании с определёнными БАД. Полученные результаты показали, что грамотное применение добавок совместно с систематическими силовыми тренировками способствует значительному увеличению мышечной силы студентов. На основе исследования разработаны практические рекомендации по оптимизации тренировочного процесса и безопасному использованию БАД в образовательной среде.

Ключевые слова

силовые качества; биологически активные добавки; технология тренировки; физическая подготовка студентов; развитие мышечной силы; спортивное питание

INTRODUCTION

Strength development is considered one of the fundamental components of physical training for university students, as it directly influences their functional preparedness, working capacity, and overall physical fitness. In recent years, the application of biologically active supplements (BAS) has gained increasing attention in sports science due to their potential to accelerate physiological adaptation, enhance muscle hypertrophy, and support recovery processes. Although traditional strength training methods remain central in physical education programs, modern research emphasizes the importance of combining training technologies with evidence-based supplementation strategies to achieve optimal results [1].

Biologically active supplements, including protein complexes, amino acids, creatine, vitamins, and mineral formulations, are widely used among physically

active populations. Their role in improving muscle contraction efficiency, energy metabolism, and post-training restoration is well documented in the international literature. However, the integration of BAS into student training programs requires careful methodological justification, considering safety, dosage, and individual characteristics. Despite the widespread availability of supplements, many educational institutions lack scientifically grounded guidelines for their effective and responsible use among students [2].

The need for innovative approaches in physical education, including the use of regulated supplementation, is further supported by increasing academic and physical demands placed on university students. Insufficient recovery, irregular nutrition, and low baseline physical fitness often reduce the effectiveness of training sessions. Therefore, the development of a pedagogically sound technology aimed at improving strength qualities through BAS use has become a relevant scientific challenge.

This study aims to investigate the impact of selected biologically active supplements on the development of strength qualities in students and to design a structured technology for their effective application within the educational process. The research is expected to contribute to the modernization of training programs and provide practical recommendations for coaches, instructors, and institutions seeking to enhance student physical development through safe and scientifically supported supplementation practices [3,4].

MATERIALS AND METHODS

This study employed an experimental research design to evaluate the effectiveness of biologically active supplements in developing strength qualities among university students. A total of 40 participants, aged 18–22, were recruited voluntarily from physical education groups. All participants were medically screened to ensure they had no contraindications to strength training or supplement use. They were then randomly assigned to two groups: an experimental group receiving biologically active supplements alongside a structured strength-training program, and a control group following the same training program without supplementation [4].

The intervention lasted eight weeks and consisted of three supervised training sessions per week. Each session included warm-up exercises, resistance training targeting major muscle groups, and a cool-down phase. The training load was progressively increased according to standard periodization principles, ensuring adequate intensity for strength development. Exercises included bench press, squats, deadlifts, and seated rowing, with workload adjusted individually based on one-repetition maximum testing [5].

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The experimental group received a combination of protein powder, creatine monohydrate, and branched-chain amino acids in standardized dosages. Supplements were administered according to established sports nutrition guidelines, with protein consumed post-workout, creatine taken daily, and amino acids used before training. Compliance was monitored through weekly check-ins and supplement logs maintained by participants [6].

To assess changes in strength qualities, pre- and post-testing were conducted using maximum strength tests for upper and lower body, hand dynamometry, and vertical jump performance. All assessments were carried out under identical laboratory conditions to minimize external variability. Data collection also included anthropometric measurements and self-reported training adherence.

Statistical analysis involved comparing pre- and post-intervention results within and between groups. Descriptive statistics were used to summarize participant characteristics, while paired and independent t-tests were applied to determine significant differences in strength indicators. The level of significance was set at $p < 0.05$. This methodological approach provided a reliable basis for evaluating the influence of biologically active supplements on student strength development [7].

RESULTS

The results of the eight-week intervention demonstrated notable differences in strength development between the experimental group, which received biologically active supplements, and the control group, which followed training without supplementation. At baseline, both groups displayed similar strength indicators across all testing variables, confirming group equivalence before the experiment. Following the intervention, both groups showed improvements in maximal strength and functional performance; however, the magnitude of progress differed substantially.

The experimental group exhibited significantly higher gains in upper- and lower-body maximal strength. Bench press performance increased by an average of 12 kg, whereas the control group improved by only 4 kg. Similar trends were found in the squat 1RM test, where the experimental group improved by 16 kg compared to a 5-kg increase in the control group. Hand dynamometry results also showed greater progress in the supplemented group, with an 8-kg improvement versus a 2-kg increase in the control group.

Explosive power, assessed through vertical jump height, showed meaningful enhancement among participants receiving supplements. The experimental group improved by 8 cm, while the control group increased by only 2 cm. These findings suggest that biologically active supplements contributed to accelerated recovery,

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improved energy availability, and enhanced muscle adaptation, which likely amplified the effects of resistance training.

Statistical analysis revealed significant differences between pre- and post-test results within the experimental group across all measured indicators ($p < 0.05$). While the control group also showed improvements, most changes did not reach statistical significance. Between-group comparisons further confirmed the superior effectiveness of integrating supplements into the training program.

Overall, the results indicate that combining structured strength training with appropriately selected biologically active supplements produces more pronounced improvements in students' strength qualities than training alone.

Table 1. Changes in Strength Indicators Before and After the Intervention

Indicator	**Control Pre**	**Control Post**	**Experimental Pre**	**Experimental Post**
Bench Press 1RM (kg)	52	56	53	65
Squat 1RM (kg)	78	83	79	95
Hand Dynamometry (kg)	38	40	37	45
Vertical Jump (cm)	36	38	36	44

DISCUSSION

The findings of this study reveal that biologically active supplements, when combined with a structured strength-training program, produce significantly greater improvements in strength qualities compared to training alone. The experimental group demonstrated superior gains in maximal strength, hand dynamometry, and explosive power, suggesting that supplements played a meaningful role in enhancing muscle adaptation and recovery processes. These results align with the physiological understanding that improved nutrient availability and optimized metabolic function contribute to increased resistance-training efficiency.

A key explanation for the enhanced performance in the supplemented group is the accelerated restoration of energy stores and improved muscle protein synthesis. Regular intake of protein and amino acids likely supported the repair of micro-damaged muscle fibers and facilitated hypertrophy. Creatine supplementation may have further contributed by increasing intramuscular phosphocreatine availability, thereby enhancing high-intensity effort and allowing participants to train with greater volume and intensity. These mechanisms collectively strengthened the overall training response [6,7].

The control group also showed improvements, confirming that the training itself was effective. However, the smaller magnitude of progress suggests that natural recovery without supplementation may not fully support the demands of progressive resistance training, especially among students with varying dietary habits, stress factors, and limited rest. This discrepancy underscores the importance of targeted nutritional support for populations experiencing high physical and academic workloads.

An important practical implication of this study is the need for structured guidelines regarding supplement use in educational institutions. While supplements are widely available, their unregulated or uninformed application may lead to misuse or insufficient results. Therefore, educators, coaches, and sports specialists should consider developing evidence-based protocols that ensure safety, individualization, and ethical use [7,8].

Overall, the discussion supports the conclusion that integrating biologically active supplements into student training programs offers a scientifically grounded strategy for enhancing strength development and optimizing training outcomes.

CONCLUSION

This study investigated the impact of biologically active supplements on the development of strength qualities in university students. The experimental results clearly indicate that students who integrated carefully selected supplements into their structured strength-training program achieved significantly greater improvements in maximal strength, hand dynamometry, and explosive power compared to those who trained without supplementation. These outcomes demonstrate that biologically active supplements can serve as effective adjuncts to conventional training methods, enhancing muscle adaptation, recovery, and overall functional performance.

The combination of protein, amino acids, and creatine facilitated enhanced energy availability, accelerated recovery, and improved muscle hypertrophy, which contributed to the superior performance observed in the experimental group. This finding reinforces the concept that strength development is not solely dependent on physical exercise but is also influenced by nutritional support and metabolic optimization. Furthermore, the study highlights that even a relatively short intervention of eight weeks can yield measurable and meaningful improvements when training is supported by scientifically grounded supplementation.

Practical implications of this research emphasize the importance of developing structured protocols for supplement use within educational and sports settings. Coaches, instructors, and physical education specialists should ensure that

supplement administration is safe, individualized, and integrated with pedagogically sound training practices. Such an approach can maximize training efficiency, prevent potential misuse, and support sustainable physical development among students.

In conclusion, the integration of biologically active supplements into strength-training programs represents a scientifically validated strategy for enhancing student physical performance. The findings of this study contribute to modernizing physical education approaches, providing evidence-based recommendations for optimizing training outcomes. Future research may explore long-term effects, optimal supplement combinations, and the interaction between dietary patterns and training responsiveness to further refine the technology for developing strength qualities in students.

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