OZIQ-OVQAT XAVFSIZLIGI: MILLIY VA GLOBAL MUAMMOLAR

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SHAROF RASHIDOV NOMIDAGI SAMARQAND DAVLAT UNIVERSITETI

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MUNDARIJA

Gapparov B. M. POLIGENOMLI DURAGAYLARNING F_1 VA F_2 AVLODLARDA TOLA UZUNLIGI BELGISINING BIOLOGIK VA GENETIK XUSUSIYATLARI…… 3-8

Turaeva B.I., Qutlieva G.J., Shonoxunov T. MIKOTOKSIN HOSIL QILUVCHI FITOPATOGEN MIKROMITSETLARGA QARSHI ANTOGONIST BAKTERIYA SHTAMMLARINI ANIQLASH ……..…….. 9-12

Xamrayev N. U., Yo‘ldasheva Sh. X. KUZGI YUMSHOQ BUG‘DOY NAVLARINING MAKROELEMENT MIQDORINI RENTGEN-FLUORESSENT USULIDA ANIQLASH…… 13-18

Xakimov A. E., Rasulov M. B., Rasulov M.B. KUNGABOQAR URUG‘LARINING MOY VA OQSIL TARKIBI BO‘YICHA MORFOLOGIK VA AGROEKOLOGIK O‘ZGARISHLARNI BAHOLASH……..... 19-23

Gapparov B. M. POLIGENOMLI DURAGAYLARDA KO‘SAK VAZNI BELGISINING IRSIYLANISHI VA O‘ZGARUVCHANLIGI……..... 24-28

Norboyev M.T., Ismailov Z. F., Xurramov A. B. POLIFUNKTSIONAL BIOPREPARAT TARKIBIDAGI KOMPLEKS BAKTERIYA SHTAMMLARINING QULUPNAY (*Albion strawberry*) ILDIZLARIGA INOKULYATSIYASI VA BIOMETRIK KO‘RSATGICHLARI TA’SIRI……..... 29-34

Tohirova O. S., Davronov K. D., Turaeva B. I. YIRIK SHOHLI QORAMOLLAR MIKROBIOMIDAN AJRATIB OLINGAN ISTIQBOLLI BAKTERIYALAR ASOSIDA YARATILGAN BIOLOGIK FAOL QO‘SHIMCHALAR 35-44

Mirzayev U.N., Narzullayev S.N. BO‘Z TUPROQ SHAROITIDA RAPS (Brassica napus L.) SIDERATINI YETISHTIRISH VA TUPROQQA ARALASHTIRISHNING AGROEKOLOGIK AHAMIYATI ……..... 45-49

Мамадиярова Д.У., Азимова С.Б., Саидмуродова З.Г. СПЕЦИФИЧЕСКИЕ АСПЕКТЫ ПОЛИМОРФИЗМА GLU298ASP (RS1799983) В ГРУППЕ, ОСЛОЖНЕННОЙ АНГИОПАТИЕЙ ПРИ САХАРНОМ ДИАБЕТЕ 2 ТИПА..... 50-53

Xoliqulov Sh.T., Bobobekov I. N., Yakubov T. B. SHO‘RTANGAZKIMYO MAJMUASI ATROFIDAGI OCH TUSLI BO‘Z TUPROQLARDA OG‘IR METALLAR MIQDORI……..... 54-59

Mo‘minov Sh.A. Narzullayev S.B. KOVRAK (*FERULA KUHISTANICA*) NEMATODAFAUNASI VA UNING BIOEKOLOGIK XUSUSIYATLARI 60-65

Shopulatova D. Sh., O‘roqov S. X. ISSIQXONA SHAROITIDA POMIDOR BO‘YINING O’SISHIGA AZOT ME’YORLARINING TA’SIRI..... 66-69

Nurkosimova R., Oltiboyev Sh., Boboqandov N.F. QORAG‘AT (*RIBES* L.) NING BIOEKOLOGIYASI VA DORIVORLIK POTENSIALI…… 70-75

Мадатова М.А., Носиров М.Г. ИСТОРИЯ ИЗУЧЕНИЯ И РАСПРОСТРАНЕНИЕ ВИДОВ РОДА *PEROVSKIA*……..... 76-79

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YIRIK SHOHLI QORAMOLLAR MIKROBIOMIDAN AJRATIB OLINGAN ISTIQBOLLI BAKTERIYALAR ASOSIDA YARATILGAN BIOLOGIK FAOL QO‘SHIMCHALAR

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Annotatsiya: Ushbu maqolada yirik shoxli qoramollarning ovqat hazm qilish tizimi mikrobiomining tarkibi va funksional xususiyatlari hamda undan ajratib olingan istiqbolli mikroorganizmlar asosida yaratilgan biologik faol qo‘shimchalarning ahamiyati ko‘rib chiqildi. Rumen mikrobiomi ozuqa parchalanishi, energiya hosil bo‘lishi va hayvon mahsuldorligida muhim rol o‘ynaydi. Tadqiqotlar natijasida probiotik mikroorganizmlar ozuqa samaradorligini oshirishi, sut hosildorligini ko‘paytirishi va metan chiqindilarini kamaytirishi aniqlangan. Ushbu yondashuv chorvachilikda ekologik barqarorlikni ta’minlashda muhim ahamiyatga ega.

Kalit so‘zlar: rumen mikrobiomi, probiotiklar, yirik shoxli qoramollar, ozuqa samaradorligi, sut hosildorligi, biologik faol qo‘shimchalar, fermentatsiya, metan emissiyasi.

Аннотация: В данной обзорной статье рассматриваются состав и функциональные особенности микробиоты пищеварительной системы крупного рогатого скота, а также значение биологически активных кормовых добавок, созданных на основе перспективных микроорганизмов, выделенных из рубца. Микробиота рубца играет ключевую роль в расщеплении кормов, образовании энергии и формировании продуктивности животных. Результаты исследований показывают, что пробиотические микроорганизмы способны повышать эффективность использования кормов, увеличивать молочную продуктивность и снижать выбросы метана. Использование пробиотиков, таких как Lactobacillus, Bacillus и Saccharomyces, способствует оптимизации процессов ферментации, стабилизации pH среды рубца и подавлению патогенной микрофлоры. Таким образом, управление микробиомом рубца является перспективным направлением повышения продуктивности животноводства и снижения негативного воздействия на окружающую среду.

Ключевые слова: микробиота рубца, пробиотики, крупный рогатый скот, эффективность кормления, молочная продуктивность, биологически активные добавки, ферментация, метан.

Annotation: This review article discusses the composition and functional characteristics of the gastrointestinal microbiota of cattle, as well as the importance of biologically active feed additives developed based on promising microorganisms isolated from the rumen. The rumen microbiota plays a crucial role in feed degradation, energy production, and overall animal productivity. Numerous studies have demonstrated that probiotic microorganisms can improve feed efficiency, enhance milk yield, and reduce methane emissions. In particular, microbial additives such as Lactobacillus, Bacillus, and Saccharomyces species positively influence rumen fermentation processes, stabilize pH, and promote the growth of beneficial microorganisms while inhibiting pathogenic bacteria. Therefore, modulation of the rumen microbiome represents a promising and sustainable strategy for improving livestock productivity and reducing environmental impact.

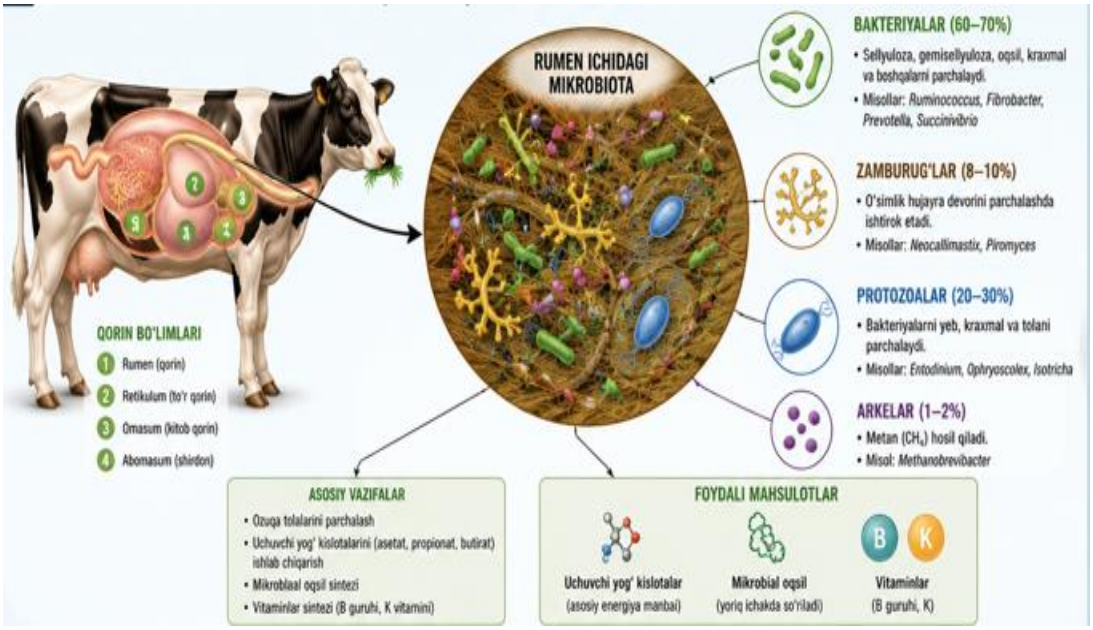
Keywords: rumen microbiota, probiotics, cattle, feed efficiency, milk production, biologically active additives, fermentation, methane emissions.

Kirish: So‘nggi yillarda dunyo miqyosida aholi sonining ortishi va turmush darajasining yaxshilanishi hayvon oqsiliga, xususan sut va sut mahsulotlariga bo‘lgan talabning keskin oshishiga olib kelmoqda. Ushbu talabni qondirishda sut chorvachiligi muhim o‘rin tutadi. Shu sababli sut chorvachiligida mahsuldorlikni oshirishning samarali, barqaror va ekologik xavfsiz usullarini ishlab chiqish dolzarb ilmiy-amaliy vazifa hisoblanadi.

Chorvachilik mahsulotlariga bo‘lgan talab ortishi bilan bir qatorda, ushbu sohaning atrof-muhitga ta’siri, xususan issiqxona gazlari chiqindilari va resurslardan foydalanish samaradorligi muammolari ham dolzarb bo‘lib bormoqda. Shu nuqtai nazardan, yirik shoxli qoramollarning ovqat hazm qilish tizimi mikrobiomini o‘rganish va undan foydali mikroorganizmlar asosida biopreparatlar yaratish orqali sut mahsuldorligini oshirish, ozuqa samaradorligini yaxshilash hamda ekologik yuklamani kamaytirish muhim ilmiy yo‘nalishlardan biri hisoblanadi **[5].** Oziq-ovqat xavfsizligi nuqtai nazaridan sut va sut mahsulotlari inson organizmi uchun zarur oqsil, vitamin va minerallar manbai hisoblanadi **[45].** Shu bilan birga, chorvachilikni rivojlantirishda asosiy maqsad faqat hayvonlar sonini oshirish emas, balki ularning mahsuldorligini genetik va biotexnologik yondashuvlar asosida samarali boshqarishdan iboratdir **[1].**

Qoramollarning ovqat hazm qilish tizimi, ayniqsa rumen mikrobiomi, ozuqa parchalanishi va fermentatsiya jarayonlari orqali energiya hosil bo‘lishi hamda sut mahsuldorligini belgilovchi asosiy biologik tizimlardan biri hisoblanadi **[8,22].** Shu bois rumen mikrobiomi tarkibi va uning funksional faoliyatini chuqur o‘rganish chorvachilik mahsuldorligini oshirishda muhim ilmiy asos bo‘lib xizmat qiladi.

Asosiy qism: Qoramol va sut sigirlarining ovqat hazm qilish tizimi mikrobiomi murakkab biologik tizim bo‘lib, u bakteriyalar, arxeyalar, protozoalar va anaerob zamburug‘lardan tashkil topgan (1-rasm). Ushbu mikroorganizmlar o‘simlik tolalarini fermentatsiya qilish orqali hayvon organizmi uchun zarur energiya va oqsil manbalarini hosil qiladi **[8].** Bundan tashqari, ular sellyuloza, oqsil va yog‘larni parchalaydigan fermentlar ishlab chiqaradi hamda vitaminlar va boshqa biologik faol moddalar sintezida ishtirok etadi. Mikrobiom muvozanati saqlangan holatda foydali mikroorganizmlar ustunlik qiladi va patogen mikrofloraning rivojlanishi cheklanadi (1-jadval). Shu sababli, rumen mikrobiomini o‘rganish va uni boshqarish sut chorvachiligida mahsuldorlikni oshirishning muhim yo‘nalishlaridan biri hisoblanadi **[22].** Tadqiqotlar shuni ko‘rsatadiki, Golshteyn zotli sut sigirlarining rumen mikrobiotasi tarkibi ularning sut berish ko‘rsatkichlari, ozuqa samaradorligi, o‘sish tezligi hamda metan chiqindilariga bevosita ta’sir ko‘rsatadi **[47].** Shu bois mikrobiom tarkibini maqsadli o‘zgartirish yuqori mahsuldorlikka erishishning istiqbolli yondashuvi hisoblanadi.



1-rasm. Yirik shoxli qoramol ovqat hazm qilish tizimi mikrobiomi.

Qoramol ovqat hazm qilish tizimi (rumen)dagi mikroorganizmlar ozuqa moddalari parchalanishi va fermentatsiya jarayonlarini amalga oshiradi. Bunda Butyrivibrio, Prevotella, Ruminococcus va Pseudobutyrivibrio kabi bakteriyalar muhim rol o‘ynaydi, ayniqsa Prevotella turi yuqori fermentativ faollikka ega hisoblanadi **[44].**

1-jadval.

Rumen mikrobiotasining asosiy guruhlari va funksiyalari.

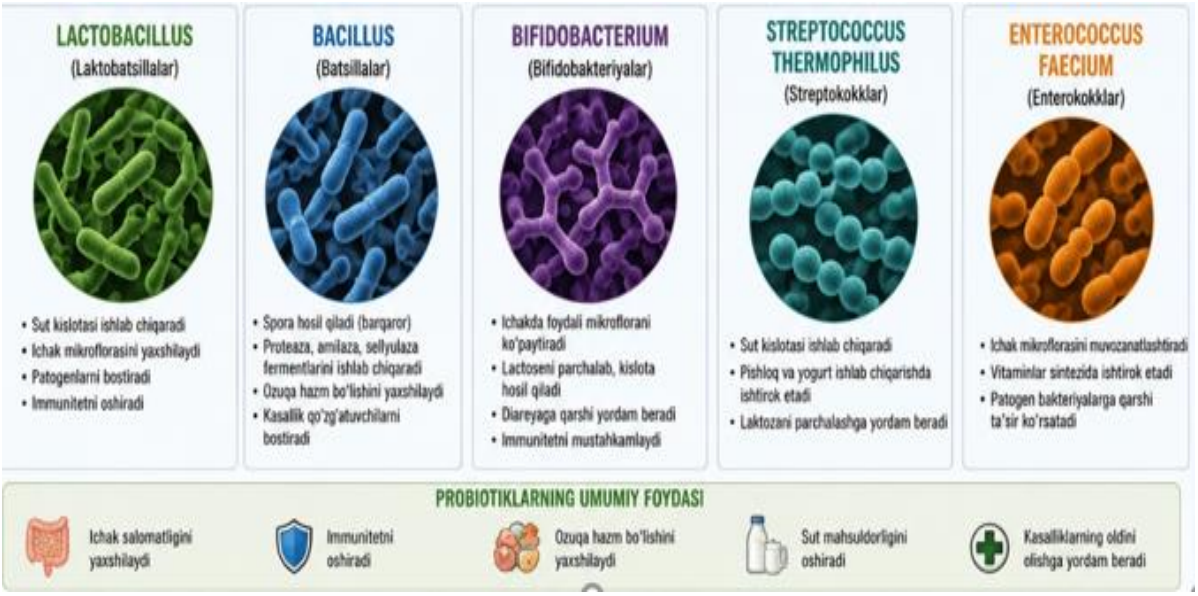
Mikroorganizmlar guruhi	Asosiy turlar	Vazifasi	Natijaviy ta’sir
Bakteriyalar	Prevotella, Ruminococcus, Butyrivibrio	Sellyuloza va kraxmal parchalanishi	Energiya hosil bo‘lishi
Arxeyalar	Methanobrevibacter ruminantium	Metan hosil qilish	Energiya yo‘qotilishi, CH_4 emissiya
Protozoalar	Entodinium spp.	Ozuqa zarrachalarini hazm qilish	Fermentatsiya muvozanati
Zamburug‘lar	Neocallimastix spp.	O‘simlik tolalarini parchalaydi	Sellyuloza hazm bo‘lishi oshadi

Ushbu mikroorganizmlar o‘simlik qoldiqlariga yopishib, sinergetik ravishda faoliyat yuritadi va uchuvchan yog‘ kislotalari hosil bo‘lishini ta’minlaydi. Yuqori va past ozuqa samaradorligiga ega hayvonlar mikrobiomi solishtirilganda, yuqori samaradorlikka ega guruhda energiya almashinuvida ishtirok etuvchi bakteriyalar, jumladan Eubacterium turlari ko‘proq uchraydi. Aksincha, past samaradorlikka ega hayvonlarda esa kam energiya hosil qiluvchi substratlarni parchalaydigan mikroorganizmlar va potensial patogenlar ustunlik qiladi **[3].** Bu holat mikrobiom tarkibi va ozuqa samaradorligi o‘rtasida bevosita bog‘liqlik mavjudligini ko‘rsatadi. Ilgari chorvachilikda o‘sish va mahsuldorlikni oshirish maqsadida antibiotiklar keng qo‘llanilgan bo‘lsa-da, ularning qo‘llanilishi bugungi kunda ko‘plab mamlakatlarda cheklangan yoki taqiqlangan. Shu sababli, tabiiy asosli biopreparatlar va probiotiklar antibiotiklarga muqobil sifatida katta ilmiy ahamiyat kasb etmoqda **[27].** So‘nggi yillarda tabiiy mikroorganizmlar va probiotiklarga asoslangan yondashuvlar keng rivojlanmoqda **[26,33].** Probiotiklar rumen mikrobiomini barqarorlashtirib, fermentatsiya jarayonlarini optimallashtiradi, natijada uchuvchan yog‘ kislotalari hosil bo‘lishi ortadi va metanogen mikroorganizmlar faolligi kamayadi **[23].** Laktobakteriyalarga asoslangan probiotiklar esa foydali mikrofloraning ko‘payishiga yordam beradi **[12].**

Probiotiklar ichak epitelial hujayralarining rivojlanishini rag‘batlantirib, ozuqa moddalari hazm bo‘lishini yaxshilaydi. Buzoqlarda Lactobacillus casei, L. salivarius va L. sakei kabi shtammlar qo‘llanilganda rumen fermentatsiya faolligi va yog‘ kislotalari miqdori oshgani, shuningdek o‘sish va rivojlanish ko‘rsatkichlari yaxshilangani kuzatilgan **[29,37].** Bundan tashqari, Bacillus amyloliquefaciens va Bacillus subtilis qo‘shimchalari ozuqa iste’molini oshiradi, energiya almashinuvini yaxshilaydi hamda qisqa zanjirli yog‘ kislotalari hosil bo‘lishini kuchaytiradi. Bu mikroorganizmlar ichak mikrobiotasini boyitib, immun va endokrin tizim faoliyatiga ham ijobiy ta’sir ko‘rsatadi **[15].** Probiotiklar umumiy ichak mikroflorasini muvozanatlashtirib, patogen mikroorganizmlarning rivojlanishini cheklaydi, diareya holatlarini kamaytiradi va immun tizimini mustahkamlaydi **[11].** Masalan, Lactobacillus johnsonii va Lactobacillus reuteri qo‘llanilganda Bifidobacterium va Akkermansia kabi foydali bakteriyalar soni ortishi aniqlangan **[46].** Bu esa buzoqlar va yosh sigirlarda o‘sish sur’ati, ozuqa samaradorligi, immun javob hamda antioksidant faollikni yaxshilaydi. Probiotiklar sut yoki boshlang‘ich ozuqaga qo‘shilganda qattiq ozuqa iste’molini oshiradi va sutdan ajratish davrida yuzaga keladigan stressni kamaytiradi **[28].**

Sutdan ajratish vaqtida buzoqlarni xavfsiz va samarali boqish jiddiy muammolar bilan bog‘liq bo‘lib, masalan, urg‘ochi buzoqlarning 5–6 % bu davrda nobud bo‘lishi mumkin. Og‘iz suti bilan oziqlantirishning kechiktirilishi foydali bakteriyalar — Bifidobacterium va Lactobacillus — sonining kamayishiga olib keladi. Shu sababli, sut beradigan buzoqlarning hayotining dastlabki davrida hamda sutdan ajratish vaqtida probiotiklardan foydalanish ichak salomatligi, uning faoliyati va kasalliklarning oldini olishga ijobiy ta’sir ko‘rsatadi **[11].** Bunday yondashuv doirasida Bifidobacterium animalis, Lactobacillus casei, Streptococcus faecalis va Bacillus cerevisiae ni o‘z ichiga olgan ko‘p shtammli probiotik mahsulot Holstein buzoqlarining umumiy sog‘ligi va ichak mikrobiota tarkibiga ijobiy ta’sir ko‘rsatgan (2-rasm). Natijada foydali Prevotella

turlari ko‘paygan, potensial patogen Dorea turlarining esa kamayishi kuzatilgan. Bu holat ovqat hazm qilish tizimi va ichakning himoya mexanizmlarini mustahkamlab, patogen mikroorganizmlar tomonidan kolonizatsiya xavfini kamaytiradi **[19].**



2-rasm. Probiotik bakteriyalar va ularning biologik ahamiyati.

Sut beruvchi sigirlarda Saccharomyces cerevisiae kabi probiotiklar ovqat hazm qilish tizimi muhitining pH darajasini barqarorlashtiradi va sellyulolitik bakteriyalar faoliyatini rag‘batlantiradi. Natijada ozuqa tolalarining parchalanishi yaxshilanadi, energiya o‘zlashtirilishi ortadi va bu sut hosildorligi hamda uning sifat ko‘rsatkichlarining oshishiga olib keladi. Probiotiklar shuningdek ozuqaning umumiy hazm bo‘lishini yaxshilaydi, quruq modda iste’molini oshiradi va ovqat hazm qilish tizimidagi fermentatsiya jarayonlarini barqarorlashtiradi. Ularning qo‘llanilishi klinik atsidoz xavfini kamaytirish, immun tizimini qo‘llab-quvvatlash hamda sut va go‘sht sifatini yaxshilashda muhim ahamiyatga ega **[43,39].**

Bundan tashqari, probiotik mikroorganizmlar organizmni oqsil, vitaminlar va qisqa zanjirli organik kislotalar bilan ta’minlaydi hamda patogen mikroorganizmlar bilan raqobatlashib, ichakda sog‘lom mikrobiologik muhitni saqlaydi **[36].** Shu sababli, hayvonlar salomatligi va ozuqa samaradorligini oshirishda biotexnologik yutuqlar muhim ahamiyat kasb etadi. Tabiiy mikroorganizmlar va probiotiklardan foydalanish chorvachilikda keng rivojlanib bormoqda **[26,33].** Ular ovqat hazm qilish tizimi mikrobiomini barqarorlashtirib, fermentatsiya jarayonlarini optimallashtiradi. Natijada uchuvchan yog‘ kislotalari hosil bo‘lishi ortadi, metanogen mikroorganizmlar faolligi esa kamayadi **[23].** Keng qo‘llaniladigan mikroorganizmlar tarkibiga Lactobacillus, Bifidobacterium, Enterococcus, Streptococcus, Bacillus, Propionibacterium, shuningdek Saccharomyces va Aspergillus kiradi **[6].** Ular sut kislotasi ishlab chiqaruvchi yoki undan foydalanadigan mikroorganizmlar sifatida faoliyat yuritib, ozuqadan samarali foydalanishni yaxshilaydi va hayvonlarning umumiy sog‘lig‘ini mustahkamlaydi (2-jadval). Biologik faol qo‘shimchalar organizmning turli tizimlariga kompleks ta’sir ko‘rsatadi **[14].** Ular markaziy asab tizimi, mineral almashinuv, mushak-skelet tizimi va laktatsiya jarayonlarini qo‘llab-quvvatlaydi. Shuningdek, detoksikatsiya jarayonlarini faollashtirib, zararli metabolitlar va ksenobiotiklarning organizmdan chiqarilishini tezlashtiradi **[7].**

2-jadval.

Probiotik mikroorganizmlar va ularning qoramollarga ta’siri

Probiotik turi	Misollar	Ta’sir mexanizmi	Natija
Lactobacillus spp.	L. casei, L. reuteri	pH barqarorlashtirish, patogen bostirish	Ichak sog‘ligi yaxshilanadi
Bacillus spp.	B. subtilis, B. amyloliquefaciens	Ferment ishlab chiqarish	Ozuqa hazm bo‘lishi oshadi
Saccharomyces cerevisiae	Xamirturush	Fermentatsiyani optimallashtirish	Sut hosildorligi oshadi
Bifidobacterium spp.	B. animalis	Immunitetni kuchaytirish	Kasalliklar kamayadi

Qoramol ovqat hazm qilish tizimidagi mikrobial qo‘shimchalar, xususan “Galaxis Frontier”, tug‘ruqdan oldingi va keyingi davrlarda sigirlar mikrobiomini qo‘llab-quvvatlab, ozuqa hazm bo‘lishi, metabolizm va sut tarkibini yaxshilaydi **[40].** Tug‘ruqdan oldingi davrda bu qo‘shimcha buzoq tug‘ilish vazni, og‘iz suti sifati va oqsil miqdorini oshiradi hamda ona organizmidagi erkin yog‘ kislotalarini kamaytiradi. Laktatsiya davrida esa sut tarkibidagi yog‘ va oqsil foizi yaxshilanadi. O‘tish davrida (tug‘ruqdan 21 kun oldin va 100 kun keyin) ushbu qo‘shimcha sut ishlab chiqarishni 2,9–4,1 kg/gacha oshiradi. Shu bilan birga, Megasphaera elsdenii ko‘payishi va Fibrobacter succinogenes kamayishi kuzatiladi **[9].** Megasphaera elsdenii — gram-manfiy, qat’iy anaerob bakteriya bo‘lib, birinchi marta 1953-yilda katta qorindan ajratilgan va sutemizuvchilarning oshqozon-ichak traktida keng tarqalgan. Megasphaera elsdenii laktatni parchalaydigan anaerob bakteriya bo‘lib, qorin atsidozining oldini olishda muhim rol o‘ynaydi **[10].**

Ichak immuniteti ona sutidagi himoya omillari, xo‘jayin genetikasi, ichak mikrobiomi va stress omillariga, jumladan sutdan ajratish jarayoniga bog‘liq. Probiotiklar esa tirik mikroorganizmlar sifatida ichak mikroflorasini barqarorlashtirib, ovqat hazm qilish jarayonini yaxshilaydi va patogen mikroorganizmlar rivojlanishini cheklaydi. Natijada ichak salomatligi, immun javob va umumiy ozuqa samaradorligi oshadi **[16].** Golshteyn sigirlarida Clostridium beijerinckii, Pichia kudriavzevii, Butyrivibrio fibrisolvens va Ruminococcus bovis kabi mikroorganizmlar sut hosildorligi va ozuqa samaradorligini oshirishi aniqlangan **[30].** Bundan tashqari, Lacticaseibacillus va Lentilactobacillus turlari sut ishlab chiqarishni oshiradi **[2].** Bacillus amyloliquefaciens H57 esa azotni saqlash, ozuqa iste’molini oshirish va metan chiqindilarini kamaytirishga yordam beradi. Bacillus licheniformis, Bacillus subtilis va Lactobacillus plantarum kombinatsiyasi ham ozuqa iste’molini sezilarli oshiradi **[13].** Emizuvchi sigirlarda mikrobiomni boyitish energiya o‘zlashtirilishini yaxshilab, sut ishlab chiqarish, yog‘ miqdori va umumiy hosildorlikni oshiradi hamda somatik hujayralar sonini kamaytiradi. Shu bilan birga metan (CH_4) chiqindilari kamayadi **[25,41].** Tadqiqotlarda 75 bosh sigir ishtirokida o‘tkazilgan tajribada probiotik qo‘shimcha berilgan guruh laktatsiya davrida nazorat guruhiga nisbatan o‘rtacha 258 litrga ko‘proq sut ishlab chiqarganligi aniqlangan. Sut tarkibidagi yog‘ va oqsil foizlarida sezilarli farq kuzatilmagan bo‘lsa-da, mikrobiota tarkibi sezilarli o‘zgarishga uchragan. Bunda uchuvchan yog‘ kislotalari metabolizmi yaxshilangan, patogen mikroorganizmlarga qarshi himoya kuchaygan hamda ozuqa samaradorligi oshganligi qayd etilgan **[35].** Fermentatsiya jarayonlari energiya va oqsil hosil bo‘lishining asosiy manbai bo‘lib, mikroorganizmlar ozuqa samaradorligi va metan ishlab chiqarishda muhim rol o‘ynaydi. Metan emissiyasini kamaytiruvchi qo‘shimchalar CH_4 ni 30–80 % gacha kamaytirishi mumkin, biroq ozuqa samaradorligiga ta’siri barqaror emas **[4].**

Bacillus subtilis natto fermentatsiyani yaxshilab, pH muvozanatini barqarorlashtiradi va ozuqa samaradorligini oshiradi **[18].** Kompleks mikrobiologik qo‘shimchalar ham metabolik faollikni kuchaytiradi **[32].** Bir nechta mikroorganizmlardan tashkil topgan kompleks qo‘shimchalar ham fermentatsiya jarayonlarini faollashtirib, mikrobiom tarkibi, metabolik faollik va energiya almashinuvini yaxshilaydi **[32].** Fermentlangan suyuq ozuqada rivojlanadigan sut kislotasi bakteriyalari va xamirturushlar

muhit pH ni pasaytirib, patogen mikroorganizmlar o‘sishini cheklaydi hamda ichak mikroekologik muvozanatini saqlaydi. Bu esa hayvonlarning o‘sish ko‘rsatkichlari va ozuqa samaradorligini oshiradi **[27].** Xamirturush qo‘shimchalari Megasphaera elsdenii ni ko‘paytirib, pH barqarorligini ta’minlaydi va yog‘ kislotalari tarkibini yaxshilayd **[2].** Saccharomyces cerevisiae mikrobiomni optimallashtirib, sellyuloza parchalanishini kuchaytiradi va laktat to‘planishini kamaytiradi. Metanogen arxeyalar (Methanobrevibacter ruminantium) esa vodorod almashinuvida ishtirok etadi **[31].** Qoramol ichak mikrobiomidan ajratilgan xamirturushlar (Pichia kudriavzevii, Candida tropicalis, Galactomyces) sellyulaza fermentlarini ishlab chiqarib, ozuqa tolalarining parchalanishini kuchaytiradi **[38].** Candida tropicalis qo‘llanilganda sut oqsili va yog‘ kislotalari oshishi kuzatilgan **[39].** Umuman olganda, mikrobial qo‘shimchalar sut tarkibi, tana vazni va ozuqa samaradorligini yaxshilaydi **[17].** Saccharomyces cerevisiae va mikrosuv o‘tlar (Spirulina platensis, Chlorella vulgaris) aralashmasi fermentatsiya jarayonlarini kuchaytirib, hayvon mahsuldorligini oshiradi. Bunday qo‘shimchalar arpa somonining parchalanishini yaxshilab, mikrobiota tarkibi hamda immunologik ko‘rsatkichlarga ijobiy ta’sir ko‘rsatadi. Mikrobiota tarkibida Bacteroidetes va Firmicutes, shuningdek Prevotella, Butyrivibrio, Ruminococcus kabi turlar ustunlik qiladi **[24, 34].**

2050-yilga kelib global aholining 9,7 milliardga yetishi chorvachilik mahsuldorligini oshirish va ekologik yuklamani kamaytirishni talab etadi **[21].** Shu nuqtai nazardan, ovqat hazm qilish tizimi mikrobiomini boshqarish va ratsionni optimallashtirish ishlab chiqarish samaradorligini oshirishda muhim omil hisoblanadi. Ratsiondagi kraxmal va sellyuloza asosiy energiya manbalari bo‘lib, ularning parchalanishi mikroorganizmlar va ularning fermentlari ishtirokida amalga oshadi. Kraxmalni parchalovchi bakteriyalar qatoriga Streptococcus bovis, Ruminobacter amylophilus, Succinimonas amylolytica va Selenomonas ruminantium kiradi. Sellyuloza parchalanishida esa sellyulolitik bakteriyalar, zamburug‘lar va protozoalar asosiy rol o‘ynaydi **[20].**

Shu sababli, rumen mikrobiomi tarkibi va uning funksional faolligini chuqur o‘rganish chorvachilikda mahsuldorlikni oshirishning muhim ilmiy yo‘nalishlaridan biri hisoblanadi. Mikrobiota va ratsion o‘rtasidagi o‘zaro bog‘liqlikni tushunish esa ozuqa samaradorligini oshirish va ekologik ta’sirni kamaytirish imkonini beradi.

Xulosa. Xulosa qilib aytganda, qoramol va sut sigirlarining ovqat hazm qilish tizimi mikrobiomi ularning sog‘ligi, ozuqa samaradorligi va sut mahsuldorligini belgilovchi asosiy omillardan biri hisoblanadi. Rumen mikrobiomi tarkibidagi bakteriyalar, arxeyalar, protozoalar va zamburug‘lar ozuqa moddalari parchalanishi hamda fermentatsiya jarayonlarida faol ishtirok etib, hayvon organizmini energiya va zarur oziq moddalar bilan ta’minlaydi. Mikrobiota muvozanatining buzilishi esa bevosita mahsuldorlikning pasayishiga olib kelishi mumkin.

So‘nggi yillarda probiotiklar, xamirturushlar va boshqa biologik faol qo‘shimchalardan foydalanish rumen mikrobiomini ijobiy tomonga o‘zgartirish imkonini bermoqda. Ular foydali mikroorganizmlar sonini oshiradi, patogen mikroblar rivojlanishini cheklaydi hamda fermentatsiya jarayonlarini optimallashtiradi. Natijada sut va go‘sht mahsuldorligi yaxshilanadi. Ayniqsa, Lactobacillus, Bacillus, Bifidobacterium va Saccharomyces cerevisiae kabi mikroorganizmlar asosidagi qo‘shimchalar ozuqa hazm bo‘lishini yaxshilab, energiya o‘zlashtirilishini kuchaytiradi va metan chiqindilarini kamaytirishga xizmat qiladi.

Shu bilan birga, antibiotiklarga muqobil sifatida tabiiy mikroorganizmlardan foydalanish zamonaviy chorvachilikda ekologik xavfsiz va samarali yondashuv sifatida muhim ahamiyat kasb etadi. Umuman olganda, ovqat hazm qilish tizimi mikrobiomini chuqur o‘rganish va uni maqsadli boshqarish sut chorvachiligida mahsuldorlikni oshirish, hayvonlar salomatligini yaxshilash hamda ekologik barqarorlikni ta’minlashda istiqbolli yo‘nalish hisoblanadi.

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BO‘Z TUPROQ SHAROITIDA RAPS (Brassica napus L.) SIDERATINI YETISHTIRISH VA TUPROQQA ARALASHTIRISHNING AGROEKOLOGIK AHAMIYATI

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Annotatsiya: Maqolada Samarqand viloyati Payariq tumanining tipik sug‘oriladigan bo‘z tuproqlari sharoitida raps (Brassica napus L.) o‘simligini siderat (yashil o‘g‘it) sifatida bahorgi mavsumda yetishtirish va uning vegetativ biomassasini tuproqqa aralashtirish agrotexnologiyasi ilmiy jihatdan tadqiq etilgan. Tadqiqotlar qishloq xo‘jaligi ekinlariga jiddiy zarar yetkazuvchi ildiz bo‘rtma nematodalari (Meloidogyne spp.) bilan kuchli darajada zararlangan maydonda tashkil etildi. Raps 2026 yil 21 martda ekilib, o‘simlikning to‘liq gullash fazasida (2026 yil 1 iyun) mexanik usulda maydalandi va 20–25 sm chuqurlikda tuproqqa aralashtirildi.

Аннотация: В статье представлены результаты изучения выращивания рапса (Brassica napus L.) в качестве сидеральной культуры в весенний период в условиях типичных орошаемых сероземов Пайарыкского района Самаркандской области. Исследования проведены на участке, сильно заражённом галловыми нематодами рода Meloidogyne. Рапс был посеян 21 марта 2026 года и заделан в почву в фазе полного цветения 1 июня 2026 года после механического измельчения на глубину 20–25 см.

Ключевые слова: рапс, сидерат, Brassica napus, биофумигация, Meloidogyne spp., серозем, органическое вещество, галловые нематоды.

Kalit so‘zlar: raps, siderat, Brassica napus, biofumigatsiya, Meloidogyne spp., bo‘z tuproq, organik modda, nematoda, agroekologik samaradorlik.

Abstract: The study evaluates the cultivation and soil incorporation of rapeseed (Brassica napus L.) as a spring green manure crop under the conditions of irrigated typical gray soils (calcic xerosols) in the Payariq district of the Samarkand region. The field experiment was conducted in an area heavily infested with root-knot nematodes (Meloidogyne spp.), exhibiting a maximum infestation index of 5 points. Rapeseed was sown on March 21, 2026, and mechanically chopped and incorporated into the soil at a depth of 20–25 cm during the full flowering stage on June 1, 2026.

Keywords: rapeseed, green manure, Brassica napus, biofumigation, Meloidogyne spp., gray soil, soil fertility, root-knot nematodes.

Kirish: So‘nggi yillarda dunyo miqyosida va respublikamizda qishloq xo‘jaligi yerlaridan intensiv foydalanish, almashlab ekish tizimlariga rioya qilmaslik hamda mineral o‘g‘itlar va kimyoviy pestitsidlarning nazoratsiz qo‘llanilishi agroekosistemalar barqarorligiga salbiy ta’sir ko‘rsatmoqda. Bu jarayonlar sug‘oriladigan bo‘z tuproqlarning degradatsiyasiga, ulardagi makro va mikroelementlar balansining buzilishiga hamda gumus miqdorining keskin kamayishiga olib kelmoqda. Organik o‘g‘itlar (go‘ng) yetishmovchiligi sharoitida tuproq biologik faolligining pasayishi tuproq muhitida fitopatogen mikroorganizmlar va fitoparazit gelmintlarning jadal ko‘payishi uchun qulay sharoit yaratmoqda. Ayniqsa, sabzavotchilikka ixtisoslashgan maydonlarda va tomorqa xo‘jaliklarida ildiz bo‘rtma nematodalari (*Meloidogyne* spp.) eng xavfli parazitlardan hisoblanib, o‘simlik ildiz tizimida bo‘rtmalar hosil qilish orqali ozuqa va suv shimilishini buzadi, bu esa hosildorlikning 50-80% gacha yo‘qotilishiga sabab bo‘ladi. Kimyoviy nematotsidlarning qimmatligi va ekologik jihatdan zararliligi tufayli ularga qarshi biologik va agrotexnik kurash usullarini, xususan, siderat ekinlarni qo‘llashni taqozo etmoqda.

Raps (*Brassica napus* L.) qisqa muddatda yuqori vegetativ biomassa hosil qilish xususiyatiga ega

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