OZIQ-OVQAT SANOATIDA PROBIOTIK MIKROORGANIZMLARNI HIMOYA QILISH UCHUN INNOVATSION TASHUVCHI MATRITSALARNI ISHLAB CHIQISH

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Annotatsiya

Funksional oziq-ovqat mahsulotlarini ishlab chiqarishda sut kislotasi bakteriyalarini (SKB) yetkazib berishning barqaror tizimlarini ishlab chiqish tobora muhim ahamiyat kasb etmoqda. Tadqiqotning maqsadi Lacticaseiobacillus casei shtammini turli mikrokapsula materiallari, jumladan, natriy kazeinat, no‘xat oqsili, maltodekstrin, shuningdek, xitozan va sirka kislotasi asosidagi ko‘p qatlamli tizimlardan foydalangan holda kapsulalash samaradorligini baholashdan iborat. Ishda mikrokapsulalarning fizik-kimyoviy xossalari, kapsulalangan kukunning chiqishi va saqlash jarayonida bakteriyalarning yashovchanligi o‘rganilgan. Olingan natijalar, samaradorligi va barqarorligi ko‘rsatkichlari bo‘yicha o‘rganilayotgan kapsulalash tizimlari o‘rtasida sezilarli farqlarni ko‘rsatdi, bu probiotik mikroorganizmlarning saqlanishini oshirish uchun oqsil matritsalaridan, ayniqsa no‘xat oqsilidan foydalanish istiqbolli ekanligini tasdiqlaydi.

Tayanch iboralar: sut kislotasi bakteriyalari, kapsulalash, Lacticaseiobacillus casei, natriy kazeinat, no‘xat oqsili, maltodekstrin

Abstract

The development of stable delivery systems for lactic acid bacteria (LAB) is becoming increasingly important in the production of functional foods. The aim of this study was to evaluate the effectiveness of encapsulating the *Lacticaseiobacillus casei* strain using various microcapsule materials, including sodium caseinate, pea protein, maltodextrin, as well as multilayer systems based on chitosan and acetic acid. The physicochemical properties of the microcapsules, the yield of the encapsulated powder, and bacterial viability during storage were investigated. The results demonstrated significant differences among the studied encapsulation systems in terms of efficiency

and LAB stability, confirming the potential of protein-based matrices, particularly pea protein for enhancing the survival of probiotic microorganisms.

Keywords: lactic acid bacteria, encapsulation, *Lacticaseiobacillus casei*, sodium caseinate, pea protein, maltodextrin.

Kirish

Sut kislotasi bakteriyalari probiotik xususiyatlari va inson salomatligiga ijobiy ta’siri tufayli oziq-ovqat sanoatida keng qo‘llaniladi. Biroq, KXBning hayotchanligi kislorod, namlik, past pH va uzoq muddatli saqlash kabi noqulay tashqi muhit omillari ta’sirida sezilarli darajada pasayadi. Shu munosabat bilan mikroorganizmlarni himoya qilish va ularning funksional faolligini saqlab qolishni ta’minlaydigan samarali kapsulalash usullarini ishlab chiqish dolzarb vazifa hisoblanadi.

Oqsil va polisaxarid matritsalardan foydalangan holda kapsulalash funksional mahsulotlar tarkibidagi probiotiklarning barqarorligini oshirishga imkon beradigan eng istiqbolli yondashuvlardan biri hisoblanadi.

Tadqiqot materiallari va usullari

Tadqiqotning obyekti sifatida Lacticaseiobacillus casei shtammi olingan. Inkapsulyatsiya uchun quyidagi materiallardan foydalanildi: natriy kazeinat, no‘xat oqsili, maltodekstrin, shuningdek, maltodekstrin, xitozan va sirka kislotasini o‘z ichiga olgan ko‘p qatlamli tizimlar.

Inkapsulyatsiya jarayoni emulsiyalash va keyinchalik quritish usuli bilan amalga oshirildi. Quruq mikrokapsulalar olingandan so‘ng fizik-kimyoviy ko‘rsatkichlar, jumladan, pH, qovushqoqlik, suvning faolligi, namlikning massa ulushi, rangi va eruvchanligi aniqlandi. MKBning yashovchanligi MRS agariga ekish usuli bilan baholandi, so‘ngra bevosita inkapsulyatsiyadan so‘ng, 2 hafta va 1 oylik saqlashdan keyin turli xil suyultirishlarda koloniya hosil qiluvchi birliklar (KHQB) hisoblab chiqildi.

Natijalar va muhokama

Tadqiqot natijalari shuni ko‘rsatdiki, matritsa turi kapsulalash samaradorligi va bakteriyalarning saqlanishiga sezilarli ta’sir ko‘rsatadi. Natriy kazeinat asosidagi mikrokapsulalar taxminan 49,5 g quruq kukun chiqishi va neytral pH qiymati (6,8) bilan tavsiflangan. Bir oy saqlangandan so‘ng, 10^{-7} nisbatda suyultirilganda XKTning o‘rtacha yashovchanligi 49 KHQB gacha saqlanib qoldi.

Qobiq turi	Miqdor (gr)	pH
Kazeinat + LAB	49.5	6.8
No'xat oqsili + LAB	22.6	7.1

Qobiq turi	Miqdor (gr)	pH
Maltodekstrin + LAB	50.2	3.0–3.5
Maltodekstrin + Kitosan + LAB	43.3	3.5

No‘xat oqsilidan foydalanish kukunning kamroq chiqishiga (22,6 g) olib keldi, ammo bakteriyalarning yuqori darajada saqlanishini ta’minladi: bir oy o‘tgach, 10−5 ko‘paytirilganda yashovchan hujayralar soni 300 KHB dan oshdi. Bu o‘simlik oqsilining kuchli himoya xususiyatiga ega ekanligidan dalolat beradi.

Maltodekstrin asosidagi tizimlar yuqori kukun chiqishini (50,2 g) ta’minladi, ammo muhitning kislotali reaksiyasi (rN 3,0-3,5) bilan ajralib turdi, bu esa saqlash jarayonida keskin pasayib ketgan XKTning yashovchanligiga salbiy ta’sir ko‘rsatdi.

Maltodekstrin, xitozan va sirka kislotasi qo‘llanilgan ko‘p qatlamli mikrokapsulalar yaxshi strukturaviy barqarorlikka ega bo‘ldi, ammo bakteriyalarning dastlabki hayotiyligi past bo‘lib, ikki haftalik saqlashdan so‘ng minimal qiymatlargacha pasaydi.

Xulosa

Olib borilgan tadqiqotlar shuni ko‘rsatdiki, Lacticaseiobacillus casei inkapsulyatsiyasining samaradorligi ko‘p jihatdan ishlatiladigan matritsaning turi bilan belgilanadi. Oqsil tizimlari, ayniqsa no‘xat oqsili asosidagi, polisaxarid va ko‘p qatlamli tizimlarga nisbatan KXTning hayotchanligini yuqori darajada saqlanishini ta’minlaydi. Olingan natijalar probiotik kulturalarning barqarorligi oshirilgan funksional oziq-ovqat mahsulotlari va nutritsevtiklarni ishlab chiqishda qo‘llanilishi mumkin.

Manbalar

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