BÖLÜM 7

NANOEMÜLSİYONLAR VE TARIMDA KULLANIMI

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GİRİŞ

Emülsiyonlar, birbiriyle karışmayan en az iki sıvı fazın genellikle biri polar (su), diğeri nonpolar (yağ) bir faz içerisinde dağılmasıyla oluşan, dışarıdan homojen görünümlü ancak mikroskobik düzeyde heterojen yapıya sahip sistemlerdir. Bu sistemlerin stabil biçimde oluşturulabilmesi için su ve yağ fazlarının yanı sıra, arayüzeyde denge sağlayan yüzey aktif maddelerin (sürfaktan) varlığı gereklidir. Başarılı bir emülsiyon formülasyonunda, sistemin stabilitesini, fizikokimyasal özelliklerini ve raf ömrünü doğrudan etkileyen en önemli faktör, uygun yüzey aktif maddenin seçilmesidir (1).

Emülsiyon sistemleri; ilaç, gıda ve kozmetik endüstrilerinde yaygın olarak kullanılmaktadır. Emülsiyonlar birçok avantaj sunmakla birlikte, özellikle farmasötik uygulamalarda sınırlı sayıda ürün formülasyonunun bulunması, genellikle bu sistemlerin fiziksel kararlılığına ilişkin sorunlarla ilişkilendirilmektedir (2). Bu bağlamda, emülsiyon sistemlerinin daha kararlı ve etkili alternatifleri olarak "mikroemülsiyon" ve "nanoemülsiyon" sistemleri geliştirilmiştir. Mikroemülsiyonlar, yüzey aktif ve yardımcı yüzey aktif maddeler yardımıyla oluşan, termodinamik olarak kararlı, berrak ve izotropik karışımlardır. Nanoemülsiyonlar ise benzer şekilde nano boyutta damlacıklardan oluşmasına

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doi: 10.37609/akya.3807.c486

Sonuç olarak, nanoemülsiyon bazlı tarım kimyasallarının kullanımı verimlilik açısından avantaj sağlasa da, çevresel risklerin kapsamlı değerlendirilmesi ve düzenleyici çerçevelerin geliştirilmesi gerekmektedir. Bu amaçla, ekotoksikolojik testlerin ve uzun dönem etkilerin incelenmesi önem taşımaktadır (64,61).

SONUÇ

Nanoemülsiyonlar, tarım sektöründe etkin madde taşıma ve uygulanabilirlik açısından önemli avantajlar sunan yenilikçi formülasyonlardır. Küçük damlacık boyutları sayesinde, aktif bileşenlerin biyoyararlanımı artmakta, hedeflenen alana ulaşımı kolaylaşmakta ve kimyasal kullanım miktarları azalabilmektedir. Bu durum, hem ekonomik verimliliği artırmakta hem de çevresel yükü azaltma potansiyeli taşımaktadır. Ancak, nanoemülsiyonların içerdiği yüzey aktif maddeler ve nanoölçekli yapılarının çevresel etkileri üzerine yapılan araştırmalar henüz sınırlıdır. Tarımda kullanılan nanoemülsiyon bazlı ürünlerin çevre ve ekosistem üzerindeki potansiyel risklerinin belirlenmesi, sürdürülebilir kullanım için kritik önem taşımaktadır. Gelecekte, nanoemülsiyonların tarımsal uygulamalarda daha geniş ve güvenli bir şekilde kullanılabilmesi için multidisipliner çalışmalarla toksikoloji, çevre bilimi ve teknoloji entegrasyonunun artırılması gerekmektedir. Böylelikle, nanoemülsiyonlar, tarımsal üretimde hem verimliliği hem de çevresel sürdürülebilirliği destekleyen yenilikçi çözümler sunmaya devam edecektir.

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