GIDA İŞLEME VE ÜRETİMİNDE YENİLİKÇİ TEKNOLOJİLER

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Editör
Cem BALTACIOĞLU
ORCID iD: 0000-0001-8308-5991

Yayın Koordinatörü
Yasin DİLMEN

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Akademisyen Kitabevi A.Ş.

Halk Sokak 5 / A Yenişehir / Ankara
Tel: 0312 431 16 33
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ÖNSÖZ

Değerli Okuyucular,

Gıda endüstrisi, tarih boyunca insanlığın en temel ihtiyaçlarından birini karşılamış ve evrimleşmiştir. Ancak, günümüzde karşılaştığımız beslenme ve gıda üretimi zorlukları, bu sektörü daha önce hiç olmadığı kadar yenilikçi bir bakış açısıyla ele almamızı gerektiriyor. İşte tam da bu noktada, sizlere sunduğumuz " Gıda İşleme ve Üretiminde Yenilikçi Teknolojiler " kitabı devreye giriyor.

Bu kitap, gıda teknolojilerindeki en son gelişmeleri, trendleri ve geleceğin gıda üretimine yönelik güncel yaklaşımları ele alarak, gıda endüstrisinde bir devrimin kapılarını aralıyor. Yazarlarımız alanında önde gelen araştırmacılar ve gıda bilimcileri olup sizi bu heyecanlı yolculuğa davet ediyorlar.

Kitabımız, bilinen yöntemlerin ötesinde elektronik burun teknolojileri, nanoteknoloji uygulamaları, üç boyutlu gıda üretimi, vurgulu elektrik alan uygulamaları, ohmik ısıtma yöntemi, probiyotikler ve protein izolatları üretimi, analiz yöntemlerinde FTIR uygulamaları, et ve deniz ürünleri teknolojisinde yeni eğilimler üzerine güncel uygulamaların yanı sıra geleneksel ürünlerin üretiminde yenilikçi yaklaşımları da kapsamaktadır.

Bu kitabın amacı, okuyucularımıza gıda dünyasının geleceğine dair heyecan verici bir bakış açısı sunmak ve bu alandaki profesyonelleri, araştırmacıları ve meraklıları bir araya getirmektir. Umuyoruz ki, bu sayfalar, gıda teknolojilerindeki dönüşümü anlamanıza yardımcı olacaktır.

Keyifli okumalar dileriz.

Saygılarımla,

Doç. Dr. Cem BALTACIOĞLU
Niğde Ömer Halisdemir Üniversitesi
Mühendislik Fakültesi Gıda Mühendisliği Bölümü

İÇİNDEKİLER

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Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD.

Doç. Dr. Erkan KARACABEY
Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD.

Dr. Öğr. Üyesi Ali Samet BABAOĞLU
Selçuk Üniversitesi Ziraat Fakültesi Gıda Mühendisliği Bölümü

Dr. Öğr. Üyesi Hümeyra ÇETİN BABAOĞLU
Selçuk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Gıda Mühendisliği AD.

Doç. Dr. Cem BALTACIOĞLU
Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü

Doç. Dr. Hande BALTACIOĞLU
Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Teknolojisi AD.

Prof. Dr. Sencer BUZRUL
Necmettin Erbakan Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD.

Arş. Gör. Katibe Sinem CORUK
Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimi AD.

Dr. Öğr. Üyesi Talha DEMİRCİ
Selçuk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü

Gözde DOĞANAY
Gıda Yük. Müh., Niğde Ömer HalisdemirÜniversitesi

Büşra Nur GÜNDOĞAN
Gıda Yük. Müh., Selçuk Üniversitesi

Prof. Dr. Erdoğan KÜÇÜKÖNER
Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD.

Doç. Dr. Cem Okan ÖZER
Nevşehir Hacı Bektaş Veli Üniversitesi, Mühendislik-Mimarlık Fakültesi, Gıda Mühendisliği Bölümü, Gıda Mühendisliği AD.

Dr. Öğr. Üyesi Ezgi DEMİR ÖZER
Kapadokya Üniversitesi, Uygulamalı Bilimler Yüksekokulu, Gastronomi ve Mutfak Sanatları Bölümü

Prof. Dr. Gülcan ÖZKAN
Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Teknolojisi AD.

Prof. Dr. Cemalettin SARIÇOBAN
Selçuk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Gıda Mühendisliği AD.

Prof. Dr. Hasan TANGÜLER
Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimi AD.

Prof. Dr. Hasan USLU
Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü

Doç. Dr. Kübra ÜNAL
Selçuk Üniversitesi Ziraat Fakültesi Gıda Mühendisliği Bölümü

Ganime Beyzanur VAR
Gıda Yüksek Müh., Nevşehir Hacı Bektaş Veli Üniversitesi

Doç. Dr. Emre YAVUZER
Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü

Arş. Gör. Mehmet YETİŞEN
Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü

BÖLÜM 1

OHMİK ISITMA TEKNİĞİNİN GIDA TEKNOLOJİSİ İÇERİSİNDEKİ YERİ VE GELECEĞİ

Ebru AYDIN[1]
Erkan KARACABEY[2]
Erdoğan KÜÇÜKÖNER[3]
Gülcan ÖZKAN[4]

OHMİK ISITMA TEKNİĞİ

Günümüzde insanlığın temel ihtiyaç kalemleri içerisinde beslenme zincirinin üyeleri önemli bir yer tutmaktadır. Burada zincir üyeleri ifadesinin kapsamı çok geniştir. İçerisinde taze hammaddeleri barındırmasının yanı sıra işlenmiş ürünler özellikle gelişmiş ve gelişmekte olan ülkeler başta olmak üzere tüm dünyada bu ürünlere erişimi olan tüm noktalarda bu kapsamda yer almaktadır. Burada işlenmiş ürünler terimini okuyucu kitlesinin bir kısmı gıda bilimi ve teknolojisi alanında bilgi sahibi olmakla birlikte bir kısım okuyucunun fikri olmadığı varsayımından yola çıkarak biraz açmakta fayda vardır. İşlenmiş ürün denildiğinde en basit haliyle tarımsal üretimden elde edilen ürünlerin gıda endüstrisi kapsamında tanımlanan her hangi bir işleme tekniği ile veya bu tekniklerin eş zamanlı veya sıralı uygulaması ile yarı mamul ya da son ürüne

[1] Dr. Öğr. Üyesi, Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD., ebruaydin@sdu.edu.tr, ORCID iD: 0000-0002-5625-040X
[2] Doç. Dr., Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD., erkankaracabey@sdu.edu.tr, ORCID iD: 0000-0002-0428-2039
[3] Prof. Dr., Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD., erdogankucukoner@sdu.edu.tr, ORCID iD: 0000-0001-9259-4800
[4] Prof. Dr., Süleyman Demirel Üniversitesi, Mühendislik ve Doğa Bilimleri Fakültesi, Gıda Teknolojisi AD., gulcanozkan@sdu.edu.tr, ORCID iD: 0000-0002-3333-7537

Ohmik ısıtmanın temel zorluğu, yüksek yağ ve protein içeriğine sahip gıdaların işlenmesi sırasında su ve tuz eksikliğinden kaynaklanan düşük ısı iletkenliğidir. Ayrıca, uygun temizlik yapılmamış bir ohmik ısıtma sistemi, elektrotlarda protein birikmesine neden olarak elektrik arkının oluşmasına yol açabilir, bu da sistemin performansının düşmesine sebep olabilir. Bu bağlamda, ticari ölçekte uygulamaya yönelik bu zorlukların üstesinden gelmek amacıyla uygun teknolojilerin tasarımı ve geliştirilmesi için daha fazla çalışma ve araştırmaya ihtiyaç vardır.

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BÖLÜM 2

GIDA SANAYİNDE VURGULU ELEKTRİK ALAN UYGULAMALARI

Sencer BUZRUL [1]

GİRİŞ

Gıdaların zararlı organizmalardan arındırılması, korunması veya uzun süre saklanabilmesi insanoğlunun varoluşundan bu yana süre gelen bir sorundur. Ateşin icadı ile pişirmenin ortaya çıkması, daha sonra gıdaların kurutularak uzun süre saklanabilmesi ve yakın geçmişte de taze meyve sebzelerin soğutularak veya dondurularak saklanması eski çağlardaki endişelerin bir kısmının ortadan kalkmasına neden olmuştur. Gerçekten de günümüzde çok farklı teknik ve işlemlerle gıdaların raf ömrü uzatılabilmekte ve uzun süre saklanabilmeleri mümkün olmaktadır. Fakat günümüz tüketicilerin endişeleri geçmiştekilerden çok farklıdır. Günümüzde tüketiciler gıdaların bozulmadan uzun süre dayanabilmelerinin yanı sıra sağlıklı, katkı maddesi içermeyen ve aynı zamanda da besleyici değeri yüksek gıdaları tercih etmektedirler.

Basit bir örnek vermek gerekirse sütün pastörizasyonu aslında işletme koşullarında süte ısıl işlem uygulayarak (Her ne kadar genel kabul sütteki pastörizasyon işleminin 72 °C'de 15 saniye olarak yapılması olsa da sütün mikrobiyal yüküne göre sıcaklık 90 °C'lere süre ise 30 saniyeye kadar çıkabilmektedir.) sütteki hastalık yapıcı bakterilerin etkisizleştirilmesi ve raf ömrünün uzatılması amacını taşır. Bu amaca ulaşırken, yani tüketilen sütü güvenli bir hale getirirken ısıl işlemin süte vermiş olduğu enerji yükünün fazlalığı nedeniyle sütün be-

[1] Prof. Dr., Necmettin Erbakan Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimleri AD., sencer.buzrul@erbakan.edu.tr, ORCID iD: 0000-0003-2272-3827

yaptıkları bilinmektedir. Yakın gelecekte PEF teknolojisinin ülkemizdeki gıda işletmeleri tarafından kullanıldığını görmek şaşırtıcı olmayacaktır.

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BÖLÜM 3

GIDA ANALİZİNDE FTIR SPEKTROSKOPİSİNİN KULLANIMI

Hande BALTACIOĞLU [1]
Katibe Sinem CORUK [2]
Gözde DOĞANAY [3]

SPEKTROSKOPİ

Spektroskopi, elektromanyetik radyasyonun madde ile etkileşiminin incelenmesi olup, radyasyonun soğurulması, yayılması veya saçılmasını içerir ve bu amaçla kullanılan tekniklere spektroskopi teknikleri adı verilir (Pérez-Juste & Nieto Faza, 2015).

ELEKTROMANYETİK SPEKTRUM

Boşlukta çok hızlı yayılan elektromanyetik dalgalar ışın veya foton olarak tanımlanırken, dalga boyları ve enerjilerine göre çok geniş bir alana yayılırlar ve dalga boyları 10^{-14} cm'den (kozmik ışınlar) başlayan ve yüzlerce metreye (radyo dalgaları) ulaşan sayısız miktarda ışın ihtiva eden sistem elektromanyetik spektrumu oluşturur. (Perincek ve ark., 2007).

[1] Doç. Dr., Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Teknolojisi AD., handebaltacioglu@ohu.edu.tr, ORCID iD: 0000-0003-0774-0872
[2] Arş. Gör., Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimi AD., sinemcoruk@ohu.edu.tr, ORCID iD: 0000-0001-5645-7200
[3] Gıda Yük. Müh., Niğde Ömer HalisdemirÜniversitesi, gdoganay33@gmail.com, ORCID iD: 0000-0002-1227-9892

(%38,87'den %22,12'ye) ve β-tabaka içeriği (%27,91'den %13,42'ye) düşerken, β-dönüş, rastgele bobin ve kümeleşmiş β-tabaka yapılarında artış (%23,09, 26,42 ve 14,94) belirlenmiştir. Böylece termosonikasyonun protein denatürasyonuna neden olduğu ifade edilmiştir (Baltacıoğlu, Bayındırlı & Severcan 2017). Benzer şekilde şeftali kaynaklı PPO ve POD enzimine sıcaklık etkisini incelemek için FTIR kullanılmış ve eğri uydurma yöntemi kullanılarak ikincil yapı içeriği yüzde olarak belirlenmiştir (Baltacıoğlu & Coruk, 2021). Sonuçlara göre PPO aktivitesine paralel olarak protein denatürasyonunu gösteren α-sarmal ve β-tabakasının azaldığı, β-dönüşünün ve kümelenmiş β-tabakasının arttığı belirlenmiştir. Ancak POD için aktivite çalışmalarının aksine, enzimin tam olarak bozulmadığı için POD'un α-sarmal yapısı arttığı ve bir rejenerasyon meydana gelebileceği belirtilmiştir. (Jun ve ark., 2020), çalışmasında ultrason işleminin yumurta beyazı proteininde ikincil yapıya etkisini FTIR spektroskopisiyle incelemiştir. 1600-1700 cm^{-1}'deki bantlar, proteinin ikincil yapısını analiz etmek için kullanılabilen amid I titreşimine ve N-H bükülmesine karşılık geldiği belirtilmiştir. Sonuçlara göre 40 kHz'lik tek frekansın α sarmalının açılmasına, β yaprağı ve T dönüşü oluşumuna neden olduğu belirlenmiştir. 20/40 kHz'lik sürekli ikili frekansın, β-tabakanın açılmasına ve ardından α-sarmal ve γ-rastgele bobinin oluşmasına neden olduğu belirtilmiştir. Başka bir çalışmada kuercetin'in mantar tirozinaz enzimi üzerine inhibitör etkisi araştırmış, enziminin konformasyonel değişikliklerini doğrulamak için FT-IR ölçümleri kullanılmıştır. Kuersetin ve tirozinaz arasındaki etkileşimle, amid I bandı 1653'ten 1649 cm^{-1}'e ve amid II bandı 1545'ten 1539 cm^{-1}'e değişmiştir. İkincil yapıdaki değişikliği belirlemek amacıyla amid I bandını analiz etmek için eğri uydurmalar kullanılmıştır. Kuersetinin tirozinaz'a bağlanması, β-yaprak ve β-dönüş içeriklerinin artmasına ve α-sarmal ve rastgele sarmal içeriklerinin azalmasına neden olmuş, bu da yapısal polipeptitlerin açılmasına ve stabilitesinde bir düşüşe yol açtığı ifade edilmiştir (Fan ve ark., 2017).

FTIR spektroskopisi kemometrik analizlerle birlikte son yıllarda yapıdaki bağların belirlenmesi yoluyla bileşiklerin miktarının tahmin edilmesi, taklit tağşişin tespit edilmesi, protein yapısal değişimleri ve yağlarda oksidasyonun belirlenmesi gibi birçok farklı gıda analizinde yaygın şekilde kullanılmaktadır.

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BÖLÜM 4

GIDA KALİTE BELİRLEMEDE ELEKTRONİK BURUNLAR VE MAKİNE ÖĞRENMESİ

Mehmet YETİŞEN [1]
Emre YAVUZER [2]
Hasan USLU[3]

GİRİŞ

Gıda kalitesi ve güvenliği, yalnızca gıda endüstrisinin gelişimi için değil, aynı zamanda insan sağlığını güvence altına almak için de önemlidir (Pu, Lin & Sun, 2019). Gıda endüstrisi için gıda kalite seviyesinin güvenirliği kadar hızlı ve zamanında tespiti de gereklidir. Gaz kromatografisi (GC), yüksek performanslı sıvı kromatografisi (HPLC) ve polimeraz zincir reaksiyonu (PCR) gibi geleneksel tespit yöntemleri, enstrümantal olarak pahalı, iş gücü gerektiren ve zaman alıcı yöntemlerden bir kaçıdır. Söz konusu tekniklerin dezavantajları, onları özellikle çevrimiçi kalite değerlendirmesi ve endüstriyel uygulamalar için sıklıkla uygun olmayan hızlı analizler için uygunsuz hale getirir (Hussain, Sun & Pu, 2019; Liu, Pu & Sun, 2017).

Gıda ürünlerinin kalitesinin doğru ve hızlı bir şekilde denetlenmesine olan talep, gıda tedarik zincirinde hijyen ve güvenlik konularının önemi nedeniyle önemli ölçüde artmıştır. Özellikle et, tavuk ve balık gibi hızla bozulan

[1] Arş. Gör., Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, mehmetyetisen@ohu.edu.tr, ORCID iD: 0000-0001-8347-4081
[2] Doç. Dr.,Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, eyavuzer@ohu.edu.tr, ORCID iD: 0000-0002-9192-713X,
[3] Prof. Dr., Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, hasanuslu@ohu.edu.tr, ORCID iD: 0000-0002-4985-7246

ması için değerli kazanımlar sağlayabilir. Tüketici tercihlerini ve pazar eğilimlerini anlama konusunda da önemli katkılar sunma potansiyeli nedeniyle, gıda endüstrisinde makine öğreniminin uygulanması, daha verimli ve güvenilir bir gıda tedarik zinciri oluşturmak için önemli bir araç olarak öne çıkacaktır.

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BÖLÜM 5

BALIĞIN TAZELİK KALİTE ÖZELLİKLERİNİ DEĞERLENDİRMEDE BAZI YENİ TEKNİKLER

Büşra Nur GÜNDOĞAN [1]
Eda ALAGÖZ [2]
Cemalettin SARIÇOBAN [3]

GİRİŞ

Balık ve balık ürünleri yüksek kaliteli protein, doymamış yağ asitleri, vitaminler ve mineraller açısından zengin olmaları nedeniyle beslenmede önemli bir yer tutmaktadır. Ayrıca tüketilen diğer etlere kıyasla daha az oranda bağ doku içermesi ve kolay sindirilebilme özelliğinden dolayı balık eti, tüketiciler için önemli bir avantaj sağlamaktadır. Fakat bozulmaya karşı çok duyarlı olması, depolanması sırasında bazı zorlukları da beraberinde getirmektedir (Duyar, 2016). Balıklarda bol miktarda endojen enzimler ve psikrofilik mikroorganizmalar bulunmakla birlikte bu mikroorganizmalar, soğuk depolama esnasında da üreyebilmektedir. Bu nedenle, balığın güvenliğinin ve kalitesinin korunması amacıyla uygulanan muhafaza yöntemi tek başına yeterli olmayıp izlenmesi de oldukça önem arz etmektedir (Wu ve ark., 2019).

Balık etinin kalitesinin en önemli faktörü olan tazelik, farklı biyolojik ve işleme faktörlerine bağlıdır. Balıklardaki et tazeliği çeşitli fiziksel, kimyasal, biyokimyasal ve mikrobiyolojik değişikliklerin derecesini göstermektedir. Tazelik değerlendirme yöntemleri, deri-göz-solungaç görünümü, koku, renk ve tekstürel özellikler ile ilişkilidir (GholamHosseini ve ark., 2007).

[1] Gıda Yük. Müh., Selçuk Üniversitesi, bngun96@gmail.com, ORCID iD:0000-0002-5122-8000
[2] Gıda Yük. Müh., Selçuk Üniversitesi, edaalagoz94@gmail.com, ORCID iD:0000-0003-3262-0231
[3] Prof. Dr., Selçuk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Gıda Mühendisliği AD., cscoban@selcuk.edu.tr, ORCID iD:0000-0001-9898-0884

Bu bölümde, balıklarda uygulanan bazı tazelik belirleme yöntemleri üzerinde durulmuştur. Literatüre göre biyonik teknikler, biyosensör ve spektroskopik tekniklerin balık tazeliğinin belirlenmesinde büyük potansiyele sahip olduğu sonucuna varılmıştır. Ayrıca, bu teknikler çevre dostu olup kimyasal reaktif ve numune hazırlama süreçlerinin minimum düzeyde olması veya ihtiyaç gerektirmediği için oldukça önemlidir.

Balıkçılık endüstrisinde balığın tazeliğini değerlendirmek amacıyla söz konusu yöntemlerin hiçbirinin tek başına kullanılmasının önerilmediği ve geleneksel yöntemlerin pratik uygulamalarda hala baskın olduğu göz önünde bulundurulmalıdır. Bu nedenle, bu yeni teknolojilerin balık endüstrisinde benimsenmesini kolaylaştırmak, balık tazeliğinin belirlenmesine yönelik mevcut mevzuat standartlarını tamamlamak veya değiştirmek amacıyla bunların kullanılması ve geliştirilmesi için daha fazla çaba gösterilmesi gerekmektedir.

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BÖLÜM 6

DENİZ ÜRÜNLERİ İŞLEME TEKNOLOJİSİNDE YENİLİKÇİ EĞİLİMLER

Eda ALAGÖZ [1]
Büşra Nur GÜNDOĞAN [2]
Cemalettin SARIÇOBAN [3]

İŞLEME TEKNOLOJİLERİ

Isıl Teknolojiler

Isıl işlem

Isıl işlemde en yaygın kullanılan metot olan sterilizasyon, tüm patojen bakteri ve sporlarını etkisiz hale getirmeyi amaçlamaktadır. Uygulanan sıcaklık 110 - 135 °C arasında değişim gösterir. Herhangi bir mikroorganizmanın ısıl direnci bulunduğu gıdanın pH, su aktivitesi ve kimyasal kompozisyonuna bağlıdır ve bu da ısıl işlemin süresini etkilemektedir (Lewis ve Heppell, 2000). Sterilizasyon, *Clostridium botulinum* sporlarının inaktivasyonunun hayati önem taşıdığı konserve deniz ürünleri için düzenli olarak uygulanır, bu da ürün kalitesinin düşmesine neden olmaktadır (Miri ve ark., 2008). Pastörizasyonda ise salmonella gibi vejetatif patojenleri inaktive etmeye yetecek kadar uzun bir süre boyunca 70 - 90°C aralığındaki sıcaklıklar uygulanır; ancak son üründe bazı mikrobiyal kalıntılar (örneğin spor oluşturucular) bulunabilmektedir. Bundan dolayı geleneksel ısıl işlemler ile farklı işleme yöntemlerinin birleştirilmesi, ge-

[1] Gıda Yük. Müh., Selçuk Üniversitesi, edaalagoz94@gmail.com, ORCID iD: 0000-0003-3262-0231
[2] Gıda Yük. Müh., Selçuk Üniversitesi, bngun96@gmail.com, ORCID iD: 0000-0002-5122-8000
[3] Prof. Dr., Selçuk Üniversitesi, cscoban@selcuk.edu.tr, ORCID iD: 0000-0001-9898-0884

ile işlem görmüş veya sadece ozonla işlem görmüş) karşılaştırıldığında renk, tekstür ve duyusal özelliklerde iyileşme gözlenmiştir. Literatürdeki çalışmalar, ozonun özellikle diğer teknolojilerle birleştirildiğinde balık endüstrisinde umut verici olduğunu göstermektedir.

SONUÇ

Bu bölümde bahsedilen yeni teknolojiler geleneksel termal pastörizasyona kıyasla daha az kalite bozulmasına neden olmaktadır. Araştırma sonuçları, ısıl olmayan teknolojilerin geleneksel muhafaza yöntemlerine büyük potansiyel alternatifleri olduğunu göstermiştir. Sinerjik teknolojilerin kombinasyonu mikrobiyal güvenliğin yanı sıra duyusal kaliteyi de artırabilir. Balıklar çabuk bozulabilen ürünler olduğundan, tedarik zinciri ve depolama sırasında düşük sıcaklığın sağlanması önemlidir. Bununla birlikte endüstriyel uygulama için bazı problemlerin çözülmesi gerekmektedir, çünkü araştırmaların çoğu hala laboratuvar aşamasındadır ve endüstriyel ortamda sınırlı sayıda deneme yapılmıştır.

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BÖLÜM 7

ET VE ET ÜRÜNLERİNDE ULTRASES TEKNOLOJİSİ

Ganime Beyzanur VAR [1]
Cem Okan ÖZER [2]

GİRİŞ

Dünya nüfusunun hızla artışı, gelecekte karşılaşılması muhtemel en kritik sorunlardan biri olarak öngörülmektedir. Bu durum, yeterli, güvenli ve sürdürülebilir gıda temin etme konusunda önemli bir zorluk oluşturacaktır (Echegaray ve ark., 2022). Gıda üretimi ve işleme, insanlık için temel bir gereksinim olmuş ve yüzyıllar boyunca teknolojinin gelişimine paralel olarak değişime uğramıştır. Bu nedenle gıda teknolojisi, teknolojik ilerlemeler ve yeniliklerle sürekli olarak gelişen bir alan haline gelmiştir. Bu gelişmeler, gıda üretiminden depolamaya, tüketime ve gıda güvenliğine kadar geniş bir yelpazeyi etkilemektedir. Gıda teknolojisi, ürünleri daha güvenli, kaliteli ve besleyici hale getirme amacı güderken aynı zamanda enerji ve kaynak kullanımını sürdürülebilir bir şekilde ele almaktadır. Son yıllarda, gıda ürünlerinin üretiminde kullanılan teknolojilerdeki önemli gelişmeler, bu alandaki sürekli değişimi vurgulamaktadır.

Günümüz tüketicileri, besin içeriği yüksek gıda ürünlerini talep ederken aynı zamanda gıda güvenliğine de büyük önem vermektedir. Bu nedenle, gıda

[1] Gıda Yüksek Müh., Nevşehir Hacı Bektaş Veli Üniversitesi, beyzanurvar@gmail.com, ORCID iD: 0000-0002-1757-7805
[2] Doç. Dr., Nevşehir Hacı Bektaş Veli Üniversitesi, Mühendislik-Mimarlık Fakültesi, Gıda Mühendisliği Bölümü, Gıda Mühendisliği AD., cemokanozer@nevsehir.edu.tr, ORCID iD: 0000-0002-2030-1412

radikallere karşı hassas olan amino asitlerin hızlı bir şekilde okside olmasını sağlamaktadır. Ayrıca sıcaklık artışı ile lipidlerin ve proteinler oksidayona daha yatkın olabilmektedir.

Ultrases uygulaması sonucunda meydana gelen bir değişim ise protein yapılarındadır. Ultrases yoğunluğuna bağlı olarak proteinlerin yapısında parçalanma, denatürasyon ve agregasyon oluşumu söz konusudur. Bu nedenle ultrases işlemi uygulanan et örneklerinde yüksek düzeyde karbonil bileşiklerin varlığı muhtemeldir.

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BÖLÜM 8

GIDA TASARIMINDA ÜÇ BOYUTLU (3D) BASKI UYGULAMALARI

Ezgi DEMİR ÖZER [1]

GİRİŞ

Gıda tasarımı, giderek ilgi çeken ve popülerleşen bir disiplin haline gelmektedir. Tüketicilerin kişisel damak zevklerine ve gıda deneyimlerine yönelik beklentilerini artırarak taleplerini yönetmeleri, gıda sektörünün bu talepleri karşılamak için alternatif üretim uygulamalarına başvurmasına ve çeşitli pazarlama fırsatları yaratmasına yol açmaktadır. Ayrıca gıda sektöründeki rekabet, yeni tat, malzeme ve gıdalardaki yenilikler, gıda üretiminde daha verimli, çevre dostu ve sürdürülebilir üretim yaklaşımı, sağlıklı ve dengeli beslenme ihtiyacı gereksinimi gıda tasarımı alanına olan ihtiyacı arttırmaktadır (Meral & Demirdöven, 2021).

Gıda tasarımı, gıda ürünlerinin tat, tekstür ve görünüm gibi tüketici deneyimlerini kişiselleştirerek optimize etmeyi amaçlar. Bu disiplin, geleneksel gıda hazırlama yöntemlerinden farklı olarak tüketicilere daha inovatif ve özelleşmiş ürünler sunmayı hedefler. Bu noktada gıda tasarımı sadece gıdanın tüketimi ve beslenme gereksinimini karşılamasının yanında gıdaların tat, tekstür, görünüm ve estetik hususundaki cazibesinin arttırılarak gıda tüketiminden daha fazla haz alınmasını sağlar (Sher & Tutó, 2015). Farklı bir bakış açısıyla, gıda tasarımı, gıda ürünlerinin sadece bir besin kaynağı olmasının ötesinde ürünü bir sanat eseri olarak kabul ederek işlemeyi hedefler. Tüm bunların

[1] Dr. Öğr. Üyesi, Kapadokya Üniversitesi, Uygulamalı Bilimler Yüksekokulu, Gastronomi ve Mutfak Sanatları Bölümü, ezgi.ozer@kapadokya.edu.tr, ORCID iD: 0000-0002-3525-5172

üretiminde en yoğun kullanılan ve başarılı olunan gıda ürünleridir. Kakao yağı içeriğindeki yağ asitleri sebebiyle yazdırma prosesinde eriyerek kolaylıkla akıtılabilmekte ve yazdırma işlemi sonrasında hızlı bir şekilde donarak stabil bir form alabilmektedir (Zhang ve ark., 2019). Çikolata ürünlerinin 3 boyutlu baskı uygulamalarında bileşimine fonksiyonel bileşenlerin eklendiği özel formulasyonlar veya estetik tasarıma sahip ürünler üretilmektedir (Çakmak ve Gümüş, 2020; Meral ve Demirdöven, 2021).

Et ve et ürünlerinin 3 boyutlu baskısının önündeki en büyük zorluk etin yazdırılabilir forma getirilmesidir. Bu nedenle çalışmalar daha çok konvansiyonel üretim ile edilen et yerine kültürlenmiş (yapay) etin 3 boyutlu baskısına yoğunlaşmıştır. Et üretiminde sürdürülebilirliğin sağlanması ve çevresel etkilerin azaltılmasını amaçlayan çalışmalarda 3 boyutlu baskı yöntemleri ile hazırlanan kültürlenmiş etlerin tüketicilerin protein ihtiyacını karşılayabilecek önemli bir kaynak olacağı düşünülmektedir (Meral ve Demirdöven, 2021; Turkal ve Gürbüz, 2023).

3D gıda baskı teknolojisinin gastronomi ve mutfak sanatları alanında da önemli avantajları bulunmaktadır. Bireysel beslenme ihtiyaçlarına ve tercihlerine göre özel olarak tasarlanmış, kişiselleştirilmiş yemeklerin yaratılabilmesi, gıda alerjisi veya yutma güçlüğü yaşayan tüketiciler için daha sağlıklı ve güvenli bir yemek deneyimi sunması 3 boyutlu gıda baskı teknolojisinin sağladığı faydalardandır. Ayrıca 3 boyutlu baskı şeflere daha önce denenmemiş tesktür ve tasarımlarla deneme yapma, yeni yemek deneyimleri yaratma fırsatı tanımaktadır. Şefler 3 boyutlu gıda teknolojisini kullanarak gıda materyallerinden karmaşık ve sıradışı heykeller ve mimari tasarımlar üretilmektedir. Tüm bunların yanı sıra yemeklerin üretilmesi sırasında meydana gelen israfın azaltılması, verimliliğin artırılması ve daha sürdürülebilir mutfak uygulamalarının gelişmesine katkıda bulunması da en önemli avantajlarındandır (Sher ve Tutó, 2015).

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BÖLÜM 9

ET ENDÜSTRİSİNE GÜNCEL ALTERNATİFLER: ET ANALOGLARI VE YAPAY ET

Ali Samet BABAOĞLU [1]
Kübra ÜNAL [2]

ET ANALOGLARI

Bitki bazlı et analogları, insan beslenmesinde hayvan etini kısmen ikame etmek için karşımıza çıkmıştır. Protein ihtiyacını karşılaması düşüncesiyle umut verici olan et analogları; geleneksel hayvansal kaynaklı ürünlere benzer bir tat, görünüm ve kısmen besleyicilik değeri sağlayabilmeleri düşüncesiyle karşımıza çıkmaktadırlar.

Et analogları üretimi, uygun hammadde temini ve diğer yardımcı maddelerin bir araya getirilip uygun teknikler kullanılmasıyla gerçekleştirilir. Ekstrüzyon yöntemi sıklıkla kullanılan bir yöntemdir. Elektrospinning, üç boyutlu yazıcı kullanımı, hücre kültürü vb yöntemler diğer tercih edilen teknikler arasında geçmektedir.

Hayvan etine benzer kabul edilebilir duyusal özellikler sağlaması için bitki bazlı bir et analoğunun yaklaşık kimyasal kompozisyonunun; %50-80 su, %4-25 protein, %2-30 karbonhidrat, %0-15 lipitler ve %0-15 katkı maddelerinden oluşması gerektiği bildirilmiştir (Chen ve ark., 2022a; Huang ve ark., 2022). Et analoglarının yapısında bulunan proteinler; esas olarak jel ağı oluşumuna

[1] Dr. Öğr. Üyesi, Selçuk Üniversitesi Ziraat Fakültesi Gıda Mühendisliği Bölümü, asbabaoglu@selcuk.edu.tr, ORCID iD: 0000-0003-4643-7454
[2] Doç. Dr., Selçuk Üniversitesi Ziraat Fakültesi Gıda Mühendisliği Bölümü, ulusoy@selcuk.edu.tr, ORCID iD: 0000-0001-9005-6160

durumu ve bu tür hücrelerin, tüm gelecek nesillerin dokusunu ahlaki olarak kirleteceği düşüncesidir (Hopkins ve Dacey 2008).

İşsizlik: Geleneksel et üreticiliği, özellikle çiftçilerin yoğun olarak çalıştığı geniş bir sektördür. Hayvancılık, sadece hayvansal gıda kaynakları olan et, süt, yumurta gibi ürünleri sağlamakla kalmaz, aynı zamanda yün, lif ve deri gibi farklı endüstriyel ürünlerin de temin edilmesine katkıda bulunur. Hayvancılık sektörü, kırsal kesimin kalkınmasına ek olarak birçok endüstriye de ham madde sağlamaktadır. Ancak, hayvan eti üretimi laboratuvar ortamında gerçekleştirilirse, bu alanda işsizlik başta olmak üzere çeşitli ekonomik problemlerin ortaya çıkması beklenmektedir (Dumont ve ark., 2017).

GELECEĞİ

Giderek artan küresel et talebi, daha fazla kaynak gereksinimi ve çevresel kısıtlamalar nedeniyle önemli bir zorluk oluşturmaktadır. Yapay et, geleneksel et için önemli bir alternatif olarak kabul edilse de, henüz daha erken aşamalarda olduğu ve sağlam bir temele sahip olması gerektiği düşünülmektedir. Sağlam bir temele oturtulabilmesi için dikkat edilmesi gereken en önemli unsurlar; gıda güvenliği sertifikasyonunu alabilmesi, besleyicilik değerinin geleneksel et düzeyinde olması ve maliyetinin ulaşılabilir düzeyde olmasıdır. Ayrıca, sosyal ve etik kısıtlamalar, doku mühendisliği, hassas kültür koşulları, güvenilir kültür ortamlarının geliştirilmesi ve büyük ölçekli biyoreaktörlerin geliştirilmesi gibi temel sorunlar da çözülmelidir. Sonuç olarak, yapay etin gelişimi sürecinde ortaya çıkabilecek çeşitli etkiler, olumlu ve olumsuz yönleriyle birlikte detaylı bir şekilde incelenmelidir. Bu etkilerin, küresel gıda endüstrisine nasıl katkı sağlayabileceği belirlenmelidir. Bu çalışmalar yoğun bir şekilde yapılırken tüketici algısı ve beklentileri de mutlaka göz önünde bulundurulmalıdır.

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BÖLÜM 10

MODİFİYE BİTKİSEL PROTEİN İZOLATLARININ ÜRETİMİ

Hümeyra ÇETİN BABAOĞLU [1]

PROTEİN

Protein, amino asit birimlerinden oluşan önemli bir gıda biyopolimeridir. Temelde karbon (%50-55), oksijen (%20-23), hidrojen (%6-7), azot (%12-19) ve kükürt (%0.2-3.0) atomları içermekte, ancak fosfor, demir, çinko, bakır gibi elementleri de ihtiva edebilmektedir. Metabolik faaliyetler açısından proteinlerin önemi büyüktür. Vücudumuz için önemli bir yapıtaşı olan proteinler enzimlerin, kasların, hormonların, bağışıklık düzenleyici organların yapısında yer alarak hayati faaliyetlere katılmaktadır. Bununla birlikte gıda endüstrisinde son ürün özellikleri üzerine de önemli etkiye sahiptir. Proteinler aroma maddeleri öncülleri olmasının yanında gıdaların üretimi, işlenmesi ve depolanması sırasında termal veya enzimatik reaksiyonlar sonucunda renk oluşumuna katkıda bulunur. Ayrıca jel oluşturma, köpük oluşturma, hidrasyon, yapı oluşturma, yüzey aktiflik, tat-koku bağlama gibi işlevsel özelliklere de sahiptir (Belitz,, Grosch & Schieberle, 2009; Saldamlı & Temiz, 2014; Ötleş ve ark., 2015).

Proteinler yalnızca ribozomda mRNA kalıbı kullanılarak amino asitlerin peptit bağlarıyla bağlanmasıyla sentezlenen makromoleküllerdir. Kısa zincirli polimerler peptit, uzun zincirli polimerler ise polipeptit veya protein olarak isimlendirilir. Proteinlerin yapısında amino asitlerin yanı sıra renk maddeleri, mineral maddeler, lipitler ve karbonhidratlar da bulunabilir (Saldamlı & Temiz, 2014).

[1] Dr. Öğr. Üyesi, Selçuk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Gıda Mühendisliği AD., humeyracetin@selcuk.edu.tr, ORCID iD: 0000-0001-9115-6470

larından vegan ürünlerin üretiminde fermantasyonla modifikasyon yararlı bir yöntemdir. Mikroorganizmaların proteolitik etkileri sonucu kırılan protein zincirlerinde hidrofobik bölgelerin açığa çıkmasıyla proteinlerin emülsifikasyon ve köpük oluşturma kapasiteleri de artmaktadır (Akharume, Aluko & Adedeji, 2021). Fermantasyon protein sindirilebilirliğini artırmakta ancak kükürtlü amino asitlerin metabolize edilmesi sonucunda protein kalitesi azalabilmektedir. Bu nedenle fermantasyonda starter kültür olarak kullanılacak suşların seçimi oldukça önemlidir (Fernando, 2022).

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BÖLÜM 11

YENİ NESİL PROBİYOTİKLERİN ÜRETİM VE UYGULAMALARINDA KARŞILAŞILAN ZORLUKLAR VE ÇÖZÜM YOLLARI

Talha DEMİRCİ [1]

PROBİYOTİK TANIMI, TARİHÇESİ

Probiyotikler yeterli miktarda alındığında konakçıya çeşitli sağlık faydaları sunan canlı mikroorganizmalar olarak tanımlanmaktadır. Son zamanlarda oldukça popüler olsa da aslında probiyotik mikroorganizmalar ile sağlık arasındaki ilişkinin tarihi eskilere dayanmaktadır. Aslında yaklaşık yüz yıldır emzirilen bebeklerin bağırsak mikrobiyotasının mama ile beslenen ve ishal olan bebeklere nazaran daha fazla miktarda bifidobakteri içerdiği bilinmekte idi ve buradan hareketle bağırsaktaki bifidobakteri sayısının bağırsak sağlığı ile doğrudan ilişkili olduğu tezi ortaya atılmıştı (Lilly ve Stillwell, 1965; Pawar ve ark., 2022). Bu konudaki çalışmalar bu teori üzerine temellendirildi ve süregelen araştırmalar bu teorinin haklı olduğunu gösterdi. 1900'lerin başlarında düzenli olarak yoğurt tüketen Bulgar köylülerin yaşam sürelerinin ortalamaya göre daha fazla olması gözlemine dayanarak Elie Metchnikoff bu durumu laktik asit bakterilerince zengin yoğurdu sık tüketmelerine bağlamış ve sağlık faydası için bağırsak mikrobiyotasının değiştirilmesi gerektiği fikrini ortaya atmıştır. Yine 1930 yılında Minoru Shirota'nın *Lacticaseibacillus casei* subsp. Shirota içeren ve ilk ticari probiyotik ürün olarak kayıtlara geçen Yakult içeceğini satışa sunması probiyotik mikroorganizmalar üzerindeki çalışmalar ve toplum faydasına sunulması açısından çok önemli bir dönüm noktasıdır

[1] Dr. Öğr. Üyesi, Selçuk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, talhademirci@selcuk.edu.tr, ORCID iD: 0000-0003-3664-3502

miş (%97.9) ve canlılık kaybı olmadan kuru buzla başka yerlere taşınabilmiştir. Benzer şekilde De Vos and Seegers (2020) de *E. hallii*'nin yüksek biyokütle verimliliğinde geliştirilebilmesi için herhangi bir hayvansal kaynak kullanmadan gıda mesabesinde (food-grade) bir gelişme ortamı hazırlamıştır. Bu gelişme ortamı şeker (glukoz veya sükroz), maya ekstraktı, bir bitkisel protein hidrolizatı (soya peptonu gibi) ve asetattan oluşmaktadır.

SONUÇ

Özetle şu ana kadar yeni nesil probiyotik adayı bu kommensallerin özellikle oksijene aşırı hassasiyetleri bir ileri aşamaya geçip ürün bazında hak ettiği popülariteye kavuşamamasının en önemli sebebidir. Fakat tüm bu zorluklara rağmen ticari olarak satışa sunulmuş ve hastalıkları önlemede fayda sunmaya başlayan yeni nesil probiyotikler bulunmaktadır. Örneğin tip 2 diyabetin yönetilmesine yardımcı olması için piyasaya sunulan ve 'probiyotik medikal gıda' olarak tanımlanan karışım (Pendulum Glucose Control, https://pendulumlife.com) içerisinde inulin, *A. muciniphila*, *C. beijerinckii*, *C. butyricum*, *Bifidobacterium infantis* ve *Anaerobutyricum hallii* içermektedir. Üretim prosesi hakkında bilgi verilmeyen bu ürün klinik testten geçmiş, güvenli ve insan tarafından iyi tolere edilebilen bir ürün olduğu ortaya konmuş ve aynı zamanda yemek sonrası glukoz kontrolünü sağladığı da tespit edilmiştir (Perraudeau ve ark., 2020). Dolayısıyla yeni nesil probiyotiklerin medikal ve gıda alanında kullanımının önünde çeşitli engeller bulunsa da araştırmacılar ve endüstri bu engelleri aşmaya başlamıştır ve bu bakterileri insanların faydasına sunmak adına hızla çalışmalar devam etmektedir.

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BÖLÜM 12

BAZI GELENEKSEL TÜRK FERMENTE ÜRÜNLERİ VE YENİLİKÇİ YAKLAŞIMLAR

Mehmet YETİŞEN [1]
Hasan TANGÜLER [2]

GİRİŞ

Gıda işleme yöntemlerinden biri olan fermentasyon, insanlar tarafından tüketilen gıdaların önemli bir kısmından sorumlu bir süreçtir (Gänzle, 2022). Arkeolojik kanıtlara erişilebilen en eski fermente edilmiş gıdalar, tahıl ürünleri, ekmek ve bira gibi ürünlerdir (Hayden, Canuel & Shanse, 2013; Arranz-Otaegui ve ark., 2018). Yaklaşık 14.000 yıl önce, fermentasyon süreçleriyle elde edilen ürünler, avcı-toplayıcı gruplardan yerleşik tarım topluluklarına geçiş sürecinin bir parçası olarak ortaya çıkmıştır ve muhtemelen bu geçişi kolaylaştırmıştır. O tarihten bu yana, bu gıdalar insan diyetlerinde sürekli bir yer edinmiş ve özellikle son zamanlarda işlevsel gıda tüketim talebi büyük ölçüde arttıkça popülerlikleri daha da artmıştır (Baker ve ark., 2022; Marco ve ark., 2021). Ancak, fermentasyon ve fermente gıdalar hakkında farklı tanımların hala mevcut olabileceğini unutmamak önemlidir.

Fermentasyon, birçok endüstriyel süreçte kritik bir öneme sahiptir. Organizmalar, stereo-seçicilik konusunda mükemmel bir performans sergileyebilirler, yüksek verim ve dönüşümlere ulaşabilirler ve düşük sıcaklıklar ve

[1] Arş. Gör., Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, mehmetyetisen@ohu.edu.tr, ORCID iD: 0000-0001-8347-4081
[2] Prof. Dr., Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, Gıda Bilimi AD., htanguler@ohu.edu.tr, ORCID:0000-0001-6425-9896

KAYNAKLAR

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BÖLÜM 13

NANOTEKNOLOJİNİN GIDA ÜRÜNLERİ ÜZERİNDEKİ KATKISI

Mehmet YETİŞEN [1]
Cem BALTACIOĞLU [2]
Hasan USLU [3]

GİRİŞ

Nanoteknoloji, multidisipliner bir alandır ve nanometre ölçeğindeki (1 ila 100 nm arası) nanomalzemelerin uygulanması olarak tanımlanır (Chandra, 2016). Birçok malzeme, nanometre ölçeğinde küçültüldüğünde benzersiz özellikler sergiler. Nihai amaç, bu benzersiz özellikleri tam olarak anlayarak çevre açısından kabul edilebilir teknikler kullanarak geliştirilmiş ve yeni ürünler oluşturmaktır. Nanokompozitler, nano yapı malzemelerinin (biyomoleküller, polimerler gibi) diğer nano yapılar veya agregatlarla birleştirilmesiyle oluşturulur (Bhushan, 2010). Nano yapılar, renk, yayılım, manyetizma, termodinamik, toksisite, çözünürlük, dayanıklılık ve optik gibi çeşitli özelliklere sahiptir. Bir nanomalzemenin biyoaktif bileşenleri işleme ve depolama sırasında korurken biyoyararlılığı ve çözünürlüğü artırma kapasitesi, tıp, tarım, kozmetik, giyim, halk sağlığı ve gıda dahil bir dizi endüstride kullanılmaktadır (Fu, 2014; Hu ve ark., 2017; Pathkoti ve ark., 2017).

[1] Arş. Gör, Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, mehmetyetisen@ohu.edu.tr, ORCID iD: 0000-0001-8347-4081
[2] Doç. Dr. Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, cembaltacioglu@ohu.edu.tr, ORCID iD: 0000-0001-8308-5991
[3] Prof. Dr. Niğde Ömer Halisdemir Üniversitesi, Mühendislik Fakültesi, Gıda Mühendisliği Bölümü, hasanuslu@ohu.edu.tr, ORCID iD: 0000-0002-4985-7246

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