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ÖNSÖZ

Değerli Okuyucular,

"Arı Ürünleri Kitabı" adlı bu eserle sizleri, arıların ve onların sunduğu mucizevi ürünlerin eşsiz dünyasına davet etmekten büyük bir mutluluk duyuyoruz. Kitapta yer alan bilgiler, doğanın armağanı olan arı ürünlerinin tarihsel, kültürel ve sağlık boyutlarını ele alarak daha derin bir anlayış sunmayı hedefliyor.

Arılar, tarih boyunca insanlık için vazgeçilmez bir yere sahip olmuştur. İlk çağlardan itibaren insanlar, arıların üretkenliğini ve doğaya olan katkılarını gözlemleyerek onlardan yararlanmışlardır. Bu bağ, yüzyıllar boyunca güçlenerek devam etmiş ve arı ürünleri beslenmeden sağlığa birçok alanda hayatımızın parçası olmuştur. Bugün de bilimsel araştırmalar, bu mucizevi ürünlerin insan sağlığı üzerindeki olumlu etkilerini desteklemektedir ve bizlere daha geniş bir perspektif sunmaktadır.

Kitap, bal, propolis, polen, arı ekmeği (perga), balmumu, arı zehri, arı sütü ve apilarnil gibi arı ürünleri hakkında detaylı ve bilimsel içerikler sunmaktadır. Her bir ürünün, kimyasal bileşimleri, sağlık üzerindeki etkileri ve kullanım alanlarına dair kapsamlı bilgiler yer almaktadır. Bu yönüyle eserimiz, hem sağlık profesyonelleri hem de arı ürünlerini yaşamlarına entegre etmek isteyen bireyler için önemli bir başvuru kaynağıdır.

Arı ürünleri son yıllarda sağlık alanında oldukça fazla ilgi görmektedir. Yapılan araştırmalar, balın doğal bir tatlandırıcı olmasının ötesinde antibakteriyel özellikleri, propolisin güçlü antimikrobiyal yapısı, polenin zengin besin içeriği ve arı sütü gibi diğer ürünlerin bağışıklık sistemini destekleme kapasitesini gözler önüne sermektedir. Özellikle bağışıklık sistemi, cilt sağlığı, yara iyileşmesi ve daha pek çok alanda arı ürünlerinin etkili olduğunu görmekteyiz. Bu nedenle, bu alanda yapılan bilimsel çalışmaların ve pratik uygulamaların paylaşılması oldukça önemlidir.

Kitap, bu değerli ürünler hakkında bilimsel bilgiye dayalı detaylar sunmakla kalmayıp, aynı zamanda onların sağlık üzerindeki etkilerini ve günlük yaşamdaki kullanım alanlarını da ele alıyor. Kitap, arı ürünlerinin faydalarını anlaşılır bir şekilde sunarken, bu bilgileri bilimsel gerçeklerle desteklemeyi hedeflemektedir. Bu bağlamda, okuyucularımıza kapsamlı bir bakış açısı kazandırmayı hedefliyoruz.

Kitabın hazırlanma sürecinde, uzman akademisyenlerden oluşan ekibimiz bilgi ve deneyimlerini bir araya getirerek, arı ürünleri üzerine derinlemesine bir çalışma ortaya koymuştur. Umarız bu eser, arıların bizlere sunduğu değerli ürünlerin öne-

mini daha geniş kitlelere tanıtarak, sağlık ve yaşam kalitesine olan katkılarını daha iyi anlamamıza vesile olur.

Bu kitapta emeği geçen tüm akademisyenlere, araştırmacılara ve katkı sunan herkese teşekkürlerimizi sunarız. Umarız ki bu çalışma, arı ürünlerinin faydalarını ve önemini daha fazla insana ulaştırarak, toplum sağlığının ve farkındalığın artmasına katkı sağlar.

Sevgi ve saygılarımızla,

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BÖLÜM 1

BAL

Ömer ÇAKMAK [1]
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1. GİRİŞ

Bal, antik çağdan beri hem bitkisel hem de hayvansal orijinli doğal bir besin maddesi olarak insanlar tarafından işleme gerek olmadan tüketilebilen tatlı özellikteki bir üründür. Bal arılarının (*Apis mellifera*, *Apis cerana indica* ve *Apis mellipodae*) doğal bilimsel modellerinde sentezlenen, arıtılan ve peteklerde depolanan bitki ile hayvanlardan nektar, şekerli tortu toplamalarından elde edilen maddedir (1-4). Arılar önce çiçek nektarını bala dönüştürürler, ardından onu kovan içindeki bal mumu peteklerinde saklarlar (5). Arıların bal sentezleme mekanizması tüm dünyada aynıdır. Ancak balın fiziksel ve kimyasal özelliklerinde gözlenen farklılıklar temelde coğrafi ve botanik kökenlere dayanmaktadır. Tat, aroma ve renkteki çeşitlilikte balın üretildiği bölgenin florası önem taşımaktadır. Yaklaşık 10.000 yıl önce yabani bal hasadının yapıldığına dair tarihsel kanıtlar bulunmaktadır. En eski kanıtın millattan önce (M.Ö.) 2400'lü yıllara ait Mısır'da bulunan yazıttır. Mısırlıların arı yetiştiriciliği ile uğraştığı ve balın doğal bir besin kaynağı olarak kullanıldığı ortaya konulmaktadır (5). Aynı zamanda tedavi amaçlı olarak da faydalanılmıştır. Benzer şekilde M.Ö. 5500'lü yıllarda Yunanlılar da dahil olmak üzere Çinliler, Romalılar, Mayalar ve Babilliler hem beslenme amaçlı hem de tıbbi özelliklerinden dolayı bal tüketmişlerdir (1). Balın bileşimi ve kalitesi, üretim sırasındaki hava ve kovan içindeki nem, nektar koşulları, balın

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ağlama ve simetrik zayıflık ile ani solunum yetmezliği önemli bulgulardır. Tanıyı doğrulamak için hem dışkı kültürü hem de doğrudan toksin testi yapılmalıdır. Toksin testi için dışkı, serum veya mide içeriği numuneleri kullanılmaktadır. Bir lavman ile dışkı kültürü elde edilebilir, ancak gliserin fitilleri elde edilemez. Dışkı örnekleri steril bir kaba konularak analize gönderilmeden önce buzdolabında saklanabilirler, ancak dondurulma işlemi yapılmamalıdır. Doğrudan toksin testinin analiz sonuçları genellikle numune alındıktan sonraki sabah sonuçlanmaktadır. Dışkı kültürlerinin sadece % 60'ı doğru sonuç verebilmektedir. En iyi test, fare deneyi testidir. Günümüzde, moleküler yöntemlerden olan polimeraz zincir reaksiyonu (PCR) tekniği kullanılarak 24-72 saat içinde *C. botulinum* sporları tespit edilmektedir (37).

İnfant botulismusun tedavisinde antibiyotik kullanımı için endikasyon yoktur. Vakaların yaklaşık %50'sinde, insan botulismi immün globulin intravenöz (insan BIG-IV) ile tedavi edilip edilmediklerine bakılmaksızın entübasyon ve ileri hava yolu uygulanmaktadır. Bununla birlikte, tedavi edilmeyenler de daha uzun süre mekanik ventilasyona ihtiyaç duyulmaktadır. Özellikle semptomların ortaya çıkmasından sonra 24 saat içinde 30 dk boyunca intravenöz olarak infüze edilen tek dozluk İnsan BIG-IV (antitoksin) uygulamasının hastanede kalış ve mekanik ventilasyon sürelerini azalttığı bildirilmiştir. İnfant botulismus vakalarının çoğunda, hastalığa neden olan bakteriler toprakta ve tozda bulunduğundan önlenemez. Bu nedenle infant botulizmus etkeni bakterileri içerebilme ihtimalinden dolayı 12 aylıktan küçük çocuklara bal yedirmemelidir. Bal, 1 yaş ve üstü insanlar için güvenlidir (37,38).

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BÖLÜM 2

PROPOLİS

Azim ŞİMŞEK [1]
Halil YALÇIN [2]

1.GİRİŞ

Propolis (arı tutkalı), bal, arı poleni, arı sütü, balmumu ve arı zehiri gibi diğer arı ürünleri ile birlikte geleneksel ve alternatif tıpta yaygın olarak kullanılan doğal bir maddedir (1). "Propolis" kelimesi "pro" (önünde, girişinde) ve "polis" (şehir, topluluk) olmak üzere iki eski Yunanca kelimeden gelmekte olup "kovan savunma maddesi" olarak tanımlanabilir (2). Propolis, M.Ö. 300'den beri insanlar tarafından geleneksel bir ilaç olarak kullanılmaktadır. Araştırmacılar, propolisin iyileştirici aktivitelerinin Romalı ve Yunanlı doktorların yanı sıra Dioscorides, Galen, Aristoteles ve Pliny gibi diğer bilim adamları tarafından da tespit edildiğini belirtmektedirler (1,3). Antik Yunanlılar, "Polyanthus" adı verilen parfümün ana bileşeni olarak propolisi kullanmışlardır (4). Erken Mısır döneminde, propolisin anti-putrefaktif özellikleri sayesinde kadavraları mumyalamak ve yaraların iyileştirilmesi amacıyla propolis kullanıldığı ifade edilmektedir (5). Modern tıbbın babası olarak kabul edilen Hipokrat, propolisi yaraları ve ülseri tedavi etmek amacıyla kullanan ilk doktorlardan biridir. Propolis, eski Persler, Araplar, İnkalar ve Yahudiler tarafından da bilinmektedir. Propolis kelimesinin İbranice karşılığı "tzori" kelimesidir. Eski Ahit'te terapötik bir balsam olarak tanımlanmıştır. Araplar ve Persler propolisi çeşitli hastalıklara karşı ilaç ve temizlik maddesi olarak kullanmışlardır (1,6). Ayrıca propolis, Avrupa'da 17. ve 20. Yüz-

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kullanımına yönelik bugüne kadar pek çok umut verici literatür verisi yayınlanmış olmakla birlikte, gıda endüstrisinde yaygın olarak kullanılacak bir uygulamanın detaylandırılabilmesi için daha fazla bilimsel çalışmanın yapılması gerekmektedir.

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BÖLÜM 3

POLEN

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1. GİRİŞ

1.1.Arı Poleni Nedir ve Nasıl Üretilir

Polen, çiçekli bitkilerin erkek organlarında meydana gelen mikroskobik yapıdaki tanelerdir. İşçi bal arıları, ziyaretleri sırasında çiçek (negatif yüklü) ve gövdeleri (pozitif yüklü) arasında oluşan zayıf elektrostatik alanı kullanarak binlerce polen tanesini bünyelerine çeker (1). Polenin rengi ve şeklinde bitki türlerine göre farklılıklar görülmektedir. Arı poleninin, ziyaret edilen bitkilere bağlı olarak beyaz-siyah, kahverengi, sarı, turuncu, sarı-mavi veya sarı-kahverengi gibi farklı renkleri görülmektedir (2). Normalde polen, 0.01 ile 0.1 mm arasında değişen çaplarda küresel bir şekle ve değişken bir genel görünümlere sahip olabilmektedir (3). Rüzgar ve su ile taşınan bitki polenlerinin yüzeyleri pürüzsüz olmakta iken polinatör böcekler vasıtasıyla taşınan polenlerin yüzeylerinde değişik girinti ve çıkıntılar olmaktadır. Arı polenlerinin fizikokimyasal özellikleri, fitokimyasal bileşenleri ve mineral içerikleri lokasyona bağlı olarak değişebilmektedir. Türkiye'de farklı bölgelerden toplanan arı polenlerinin protein, kül, mineral gibi bazı bileşim ve fitokimyasal özellikleri incelenmiş ve bu özelliklerin yöreden yöreye farklılık gösterebileceği belirtilmiştir (4).

Polen tanelerine, arının arka bacaklarındaki birkaç tarak ve kıllar kullanılarak bir miktar tükürük salgıları ve nektar ile yapışkanlık kazandırılır. Böyle-

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rilen tüm literatür bilgileri göz önüne alındığında, toplandığı bitki türü, toprak yapısı, iklim gibi bir çok etken arı poleninin içeriğindeki bileşenlerin farklı olmasına neden olmaktadır. Fenolikler, yağ asitleri, vitamin ve mineraller gibi sağlıklı bileşikler için de iyi bir kaynak olması insanlar için potansiyel olarak faydalı bir gıda takviyesidir. Tüketiminde ise nem oranı göz önünde bulundurularak saklama koşulları dikkate alınmalıdır.

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BÖLÜM 4

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1.GİRİŞ

1.1.Arı Ekmeği Nedir ve Nasıl Üretilir

Bal arıları çiçekleri ziyaret ettiğinde sert vücut kıllarına yapışan polenleri orta bacaklarındaki fırça yardımıyla toplar ve ağzından çıkardığı bir miktar salgı ile de nemlendirerek birbirlerine yapışmasını sağlar. Daha sonra bu oluşturduğu poleni yine orta bacaklarının yardımıyla arka bacaklarındaki polen sepetine yerleştirir. Polen yüklü olarak kovana dönen arılar boş veya kısmen dolu olan petek gözüne sepetçiğindeki polen peletlerini boşaltır. Kovan içinde hizmet gören başka bir işçi arı ise polen peletlerini parçalayıp karıştırarak yayar. Depolama işlemi sırasında işçi arı bir miktar tükürük salgısıyla poleni nemlendirir ve üzerini bal ile kaplayarak havayla ilişkisini keser. Böylece polene bal, nektar ve tükürük salgısı karışmış olur. Bu şekilde depolanmış polene "arı ekmeği" denir (Şekil 1) (1,2,3). Arı ekmeği, bal ve balmumu ile üzeri sıkıca kapatıldıktan sonra çeşitli enzimler, mikroorganizmalar, nem ve sıcaklığın etkisi ile fermantasyona uğrar (4). İçerik olarak üretildiği polene çok benzemekle birlikte arı ekmeği polenden daha yüksek besin değeri ve daha fazla kimyasal bileşene sahiptir. Su, protein, esansiyel aminoasitler, lipit, karbonhidrat, mineraller, vitaminler, laktik asit, ka-

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nan β-sitosterolün kolesterol emilimini engelleyerek kan kolesterol seviyesinde düşüşe neden olabileceği belirtilmektedir (8). Yapılan çalışmalarda, günde 2 g sterol alımının kolesterol emilimini ortalama %30-40 ve LDL kolesterolü ortalama %10 azalttığı görülmüştür (34). Ayrıca arı ekmeği mide ülserine karşı epitel hasarını azaltarak koruyucu ve tedavi edici etkiye sahiptir. Diğer arı ürünlerine nazaran yapılan çalışmaların arı ekmeği üzerinde daha az olduğu görülmekte ve biyolojik etkilerinin açıklanabilmesi için daha çok bilimsel çalışmaya ihtiyaç duyulmaktadır.

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BÖLÜM 5

BAL MUMU

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1. GİRİŞ

Bal mumu, Batı bal arısı veya Avrupa bal arısının (*Apis mellifera* L.), 4ncü ve 7nci karın sternitlerinin iç tarafında yer alan dört çift özel bal mumu bezinin kullanılarak işçi arıların üretmiş olduğu karmaşık lipid bazlı organik bir bileşiktir (1,2). Bal mumu, bal arılarının ön ayaklarıyla mandibulalarına aktardıkları, bal mumu pullarını çiğneyerek tükürük salgılarının eklenmesi ve daha sonrasında inşa edilen peteklere bal mumu pulları şeklinde salgılanmasıyla elde edilir (3). Kimyasal olarak bal mumu; yağ asidi esterleri, hidrokarbonlar ve serbest yağ asitleri ağırlıklı olmak üzere 300'den fazla bileşiğin oluşturduğu karmaşık bir organik yapıdır. Farklı *A. mellifera* alt türlerinden kaynaklanan mumun temel kimyasal bileşiminde önemli farklılıklar yoktur, yalnızca bileşiklerin oranıyla ilgili küçük farklılıklar bulunmaktadır (4). Peteğin olağanüstü altıgen hücre yapısı, yüzyıllardır bilim adamlarının ve halkın ilgisini çekmiştir. Bu karakteristik mimari yapı, bal mumunun puldan peteğe dönüşümü sürecinde bal mumunun kimyasal ve mekanik modifikasyonlarının yanı sıra kendi kendine örgütlenmeleri açısından bal arılarının karmaşık bir davranışını yansıtmaktadır. Bal arıları, bal ile polenin depolanması ve kuluçka yetiştirme bölmesi rolünü üstlenen peteğin inşa edilmesinde yapı malzemesi olarak bal mumunu kullanırlar. Bal mumu, bir bal arısı kolonisindeki kimyasal iletişim için de önemlidir; karakteristik kimyasal bileşi-

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BÖLÜM 6

ARI ZEHRİ

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1. GİRİŞ

Arılar, hayvanlar içerisinde; Arthropoda (eklem bacaklılar) şubesi, Antennata (antenliler) alt şubesi, insecta (böcekler) sınıfı, Hymenoptera (zar kanatlılar) takımı, Apidae (arılar) ailesi içerisinde bulunurlar. Yaklaşık olarak 25.000 civarında arı türü olduğu düşünülmektedir. Bu türler arasında bal arısı haricindeki diğer türler yaban arıları olarak tanınır. *Apis mellifera* dışında 10 kadar tür daha bal arısı olarak bilinmektedir. Ancak bu türler genellikle Uzak Doğu coğrafyasında yaşarlar. Türkiye'nin topoğrafyası, iklim şartları ve coğrafi konumu, florasının zenginliği gibi etkenler arı faunasının çeşitli olmasını sağlamıştır (1, 2).

Bal arısının yeryüzündeki varlığı insanoğlundan çok daha eski tarihlere dayanır. Arılar sosyal bir düzen içerisinde çeşitli görevleri yapar, koloniler halinde ve sosyal bir uyum içerisinde yaşar. Bu düzenli yaşam biçimleri ile kutuplar hariç dünyanın farklı bölgelerinde bulunan ortamlara uyum sağlayarak, tüm yeryüzünde yayılım gösterirler (3, 4, 5).

Arı zehri arılarının karın boşluğunda bulunan bezlerden salgılanarak zehir kesesinde depo edilmektedir, içerisinde melittin (%50-55), apamin (%2-3) ve adolapin (%1) gibi biyoaktif peptidleri, histamin (%0.7-1.5), noradrenalin ve

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Kanatlı hayvan yetiştiriciliğinde arı zehirinin özellikle immunomodulator ve immun sistemi destekelyici etkilere sahip olması nedeniyle arı zehiri beyaz et üretimi için yetiştirilen broiler civcivlerinde arı zehiri spreyle uygulanarak immunoprofilaktik *Salmonella gallinarum*'a karşı incelenmiş ve sonuç olarak *S. gallinarum* ile ilişkilendirilen nonspesifik antikor oluşumunun tetiklendiği ve özellikle enfekte olmuş civcivlerde ise canlı ağırlık artışı gözlenmiştir (82).

Yara iyileşmesi üzerinde yapılan deneysel bir çalışmada sırt kısımlarına eşit büyüklükte yara açılan iki grup fareye arı zehiri uygulanmış ve sonuç olarak kontrol grubuyla karşılaştırıldığında, arı zehiri uygulanan grupta yaralarda daha hızlı bir iyileşme, yara boyutlarında ise küçülme tespit edilmiştir. Ayrıca kollajen miktarlarında da artış görüldüğü bildirilmiştir (31).

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BÖLÜM 7

ARI SÜTÜ VE APİLARNİL

Tuncer ÇAKMAK [1]
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Yakup Can SANCAK [3]

1. GİRİŞ

Yüzyıllardır farklı medeniyetler tarafından çeşitli hastalıkların tedavisinde kullanılan bal, propolis, arı sütü, arı poleni, balmumu ve arı zehiri gibi biyoaktif bileşenleri içeren çok sayıda ürün arılar tarafından üretilmektedir. Bu aktif bileşenler; birçok ülkede gerek nutrasötik ve besin takviyesi gerekse de tamamlayıcı ve bütünleştirici tıbbın bir parçası olarak kabul edilen apiterapi (hastalıkları önlemek veya ilerlemelerini kontrol etmek için terapötik/profilaktik ajanlar olarak arılar veya ürünleri ile yapılan tedavi) kapsamında değerlendirilmektedir (1, 2, 3).

1.1. Arı Sütü

Arı kovanı içerisinde yer alan kraliyet hücresindeki besin bileşimi; ilk olarak Hollandalı doğa bilimci, mikroskopist ve entomolog olan Jan Swammerdam (1637-1680) tarafından tanımlanmıştır. 17. yüzyıla kadar bir kral olduğu düşünülen arı kovanı şefinin aslında bir kraliçe olduğunu keşfeden ilk bilim insanı olarak kayıtlara geçmiştir. İlerleyen dönemlerde Fransız bilim insanı René

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çözünen bu molekül, hücresel enerji üretimi ve antioksidan mekanizmalar içerisinde yer almaktadır. Bunun yanında threonin (122.69 mg/100 g), lösin (106.82 mg/100 g), izolösin (49.47 mg/100 g), valin (81.35 mg/100 g), fenilalanin (63.12 mg/100 g), triptofan (32.41 mg/100 g), lizin (120.79 mg/100 g) ve metiyonin (38.24 mg/100 g) gibi yüksek düzeyde esansiyel aminoasit içeriğine sahiptir (94, 98).

1.2.2. Apilarnil Sonuç

Apilarnil, belirtilen bu biyolojik ve farmasötik özellikleri nedeniyle diğer arı ürünlerinde olduğu gibi sağlığın iyileştirilmesi ve geliştirilmesi açısından alternatif fırsatlar sunmaktadır. Yapılan araştırmalar, apilarnilin sağlık açısından önemli potansiyele sahip bir arı ürünü olduğunu göstermektedir. Gastrointestinal hastalıklar, vertigo, solunum yolu hastalıkları, kas yorgunluğu, oftalmik hastalıklar, diş ağrısı, yanık, yara, cilt temizleyici ve sırt ağrıları gibi farklı amaçlarla insanlar tarafından tercih edilebilmektedir. Özellikle prolaktin, progesteron, testosteron ve östradiol hormonları bakımından oldukça zengin olan apilarnil, infertilite problemlerine karşı başarıyla kullanıldığına yönelik veriler bulunmaktadır.

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