BÖLÜM

13 KAROTENOİDLER

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GİRİŞ

Karotenoidler, sarı, kırmızı ve turuncu pigmentler için kullanılan genel bir terimdir. Doğada, bitkiler, algler, mantarlar ve bakteriler tarafından biyosentezlenen 1100'den fazla karotenoid tanımlanmıştır. Karotenoidlerle ilgili çalışmaların, 200 yılı aşan bir geçmişe sahip olduğu düşünülmektedir. Karotenoid terimi, ilk olarak 1831 yılında Weckenroder tarafından havuçdan (*Daucus carota L.*) C_{40} yapısına sahip karotenin (β-karoten) izole edilmesiyle ortaya çıkmıştır. Daha sonra 1837'de Berzelius'un sonbahar yapraklarındaki sarı renkli bileşikleri ksantofiller olarak isimlendirmesi, karotenoidler ile ilgili araştırmaların başlangıcını oluşturmuştur. Karotenoidlerin tarihinde bir dönüm noktası yirminci yüzyılın başlarında meydana gelmiştir. 1906'da Rus botanikçi bu pigmentlerin kromatografik ayrılması tekniğinde ilk adımı atmıştır. Daha sonra, 1965'te kütle spektrometrisinin (MS) ve 1971'de yüksek performanslı sıvı kromatografisinin (HPLC) kullanılmaya başlanmasıyla birlikte araştırmalarda büyük ilerlemeler sağlanmıştır.

Karotenoidler, meyveler, sebzeler, mantarlar, kuşlar, balıklar, sürüngenler, kabuklu hayvanlar ve böceklerin kütiküllerinin yanı sıra su bitkileri olan alglerin sarıdan kırmızıya renk çeşitliliğine büyük ölçüde katkıda bulunur. Ayrıca proteinler ve lipoproteinlerle kompleksler oluşturarak yeşil ve mavi tonları da dahil olmak üzere daha geniş renk yelpazesi oluşturmaktadır. Hayvanlar aleminde gözlenen birçok renk, genellikle hayvanların diyetlerinde bulunan karotenoidlerin varlığına bağlıdır. Örneğin kuşlarda eş seçimi ve çekim gibi biyolojik olaylar hayvanın sağlıklı olduğuna işaret eden parlak renklerle desteklenmektedir. Pigmentasyon yeteneklerinin yanı sıra, hücre büyümesi, farklılaşması, üreme, bağışıklık sisteminin korunması ve görme üzerine etkilerine ek olarak mükemmel antioksidan özelliklere sahip oldukları gösterilmiştir. Karotenoidlerin, bitkilerde fotosentez sırasında ışığı toplama, bitkiyi ışığın zararlı etkilerinden koruma, bitkisel bir hormon olan absisik asidin öncü maddesi olma gibi çeşitli biyolojik işlevleri bulunmaktadır.

Kırmızıbiber, domates, havuç ekstraktları ve safran gibi doğal renk pigmentleri, hayvansal ürünlerin (deri, süt, yumurta, tereyağı ve peynir) renklendirilmesinde kullanılmaktadır. Örneğin; astaksantin içeren deniz bitkilerini tüketen somonların etleri pembe rengini almıştır. Bitkilerde

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DOI: 10.37609/akya.3790.c136

taminler (A, C, D, E), karotenoidler ve bazı mikro elementler önemli immünomodülatörlerdir. Meyve ve bitkilerde bulunan lipofilik karotenoidler mükemmel anti-inflamatuar ve antioksidan özelliklere sahiptirler. β-karoten, lutein, kantaksantin, likopen ve astaksantini içeren bitkisel pigmentler, antioksidanlardır ve bağışıklık üzerinde etkilidirler.

Karotenin timus bezinin büyümesi üzerinde belirgin bir uyarıcı etkisi olduğu ve lenfositlerin sayısında artış meydana getirdiği gözlenmiştir. Sıçanlarda, domuzlarda ve sığırlarda da benzer sonuçlar oluşturduğu görülmüştür.

Kanatlı hayvanların bağışıklık sistemlerinin güçlü olması son derece önemlidir. Bağışıklığı desteklemek için en uygun kaynaklardan biri antioksidan içeriği yüksek olan karotenoidlerdir. Ayrıca yumurta bileşeni olarak insan sağlığına da olumlu etki yapacağı açıktır. Kanatlı türlerinde, karotenoidler bağışıklık organlarında birikme eğilimindedir. Damızlık diyetine karotenoidler eklendiğinde tavukların timus ve bursa fabriciuslarında önemli miktarlarda birikim olduğu görülmüştür.

Süt ineklerinde, β-karoten ve A vitamininin yavru zarlarının atılamaması, metritis insidansı ve bağışıklık fonksiyonu üzerindeki etkileri değerlendirmiştir. β-karoten takviyesinin, nötrofilllerin bakterisit aktivitesini tutarlı bir şekilde etkilemediği görülmüştür. Kuru dönemde β-karoten ilaveli yem tüketen geviş getiren hayvanlarda, lenfosit ve nötrofillerin aktivasyonu sonucu meme bezi enfeksiyonlarının azaldığı rapor edilmiştir.

Kanatlı yemlerinde kullanılan başlıca doğal karotenoid kaynakları sarı mısır, mısır gluten unu ve alg unudur. Bir ksantofil karotenoid olan kurkumin, *Curcuma longa* bitkisinden elde edilen zerdeçalın ana aktif bileşenidir. Güneydoğu Asya'da, körilerde baharat ve renklendirici madde olarak kullanılan kurkumin; sadece bir gıda boyası değil aynı zamanda önemli bir vücut temizleyicisidir. Antiinflamatuar, antioksidan, antikarsinojenik, antibakteriyel, antiprotozoal, antiviral ve hipokolesterolemik etkileri bulunmaktadır. Lutein, kadife çiçeğinde doğal olarak bulunan bir ksantofil karotenoiddir. Yapılan çalışmalarda, luteinin humoral ve hücresel bağışıklığı ve makrofajların fagositik aktivitelerini artırabildiği; böylece hayvanlarda tümör hücresi çoğalmasını engellediği gösterilmiştir. Karotenoidlerin (özellikle kurkuminin) etlik piliçlerin bağırsak morfolojisi, sindirim, immünomodülasyon ve pigmentasyon üzerinde olumlu etkileri olduğu bulunmuştur. *E.coli* tehdidi altındaki hindilere lutein ilavesinin proinflamatuar IL-1β gen ekspresyonunu azalttığı tespit edimiştir. Karotenoidler, inflamatuar parametreleri azaltarak inflamasyonun etkisini azaltmıştır.

Sonuç olarak, hayvan beslemede sentetik katkı maddelerine karşı tüketici endişelerinin artması nedeniyle doğal karotenoid katkı maddelerinin kullanımı önemlilik kazanmıştır. Karotenoidlerin yem katkı maddesi olarak kullanılması, hayvan sağlığını, performansını iyileştirmekte ve dolayısıyla ürünlerin (et, süt, yumurta vb.) besin değerini arttırarak hayvansal üretimin kalitesini yükseltmektedir.

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