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Farklı Ekim Zamanı, Bakteri ve Gübre Çeşidinin Van Ekolojik Koşullarında Yetiştirilen Çemen *(Trigonella Foenum Graecum* L.*)* Otunun Besin Madde İçeriği ve *İn Vitro* Besin Madde Sindirilebilirliğine Etkisi

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Çemen otu
Besin madde içeriği
İn vitro
Sindirim

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ÖZ

Çalışma Van YYÜ Ziraat Fakültesi deneme arazisinde 1 ve 20 Nisan 2012 tarihinde ekimi yapılan çemen bitkisi kuru otunun kalite özelliklerini incelemek amacıyla yürütülmüştür. Ekimde rhizobium bakteri inokulantı, diamonyumfosfat (DAP), kentsel arıtma çamuru (KAÇ), humik asit (HA), çiftlik gübresi (ÇG) uygulanmıştır. Elde edilen çemen otlarının kuru madde (KM), ham kül (HK), organik madde (OM), ham protein (HP), nötral deterjan fiber (NDF), asit deterjan fiber (ADF) değerleri ve *in vitro* KM, HK ve OM sindirimleri tespit edilmiştir. Çalışma sonunda 20 Nisanda, bakteri ve humik asit uygulamasının hayvan besleme açısından besin madde içeriklerini göreceli olarak artırdığı belirlenmiştir. *İn vitro* sindirim değerleri dikkate alındığında ise 1 Nisanda ekimi yapılan çemen bitkisine bakteri uygulaması ve DAP gübresi kullanılmasının daha iyi olduğu sonucuna varılmıştır. Ancak tek yıllık sonuçlar tarımsal üretimde çok fazla dikkate alınmamaktadır.

The Effect of Differrent Sowing Time, Bacteria and Fertilizer Types on Nutrient Content and *in Vitro* Nutrient Digestion of Fenugreek (*Trigonella Foenum Graecum* L.) Grown in Van Ecological Conditions

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Research Article

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ABSTRACT

The study was carried out to examine the quality characteristics of the fenugreek's dry weed planted on April 1 and 20, 2012 in the experimental field of Van YYU Faculty of Agriculture. Rhizobium bacteria inoculum, diammonium phosphate (DAP), urban sewage sludge (USS), humic acid (HA), farm manure (FM) were applied in sowing. Dry matter (DM), ash, organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and in vitro digestions of DM, ash and OM of dry weeds were determined. At the end of the study, for April 20 groups, it was determined that the

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Keywords

Fenugreek grass
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application of bacteria and humic acid relatively increased the nutrient content in terms of animal nutrition. Considering the in vitro digestion values, it was concluded that the application of bacteria and the use of DAP fertilizer on the fenugreek plant planted on April 1 were better. However, one-year results are not taken into account much in agricultural production.

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Giriş

Türkiye'de yaygın olarak kültürü yapılan *Trigonella foenum graecum* L. türü 30-60 cm boylanabilen çiçekleri 8-10 mm boyunda, baklaları ise 5-11 cm uzunlukta ve 10-20 adet arasında tohum taşıyan bir bitkidir (Gençkan, 1983; Gökçe ve Efe, 2016). Ülkemizde 2020 yılı verilerine göre çemen bitkisi üretim miktarının 713 ton olduğu bildirilmektedir (TÜİK, 2021).

Çemen polisakkaritler, flavonoitler, saponinler, sabit yağlar ve bazı alkoloitler (trigonellin, kolin), demir, kalsiyum, fosfor ve vitaminler gibi önemli kimyasal bileşenler bakımından zengin bir bitkidir. Bitkinin, tohumunda bulunan bol miktardaki galaktomannandan dolayı laktasyonu artırdığı ve içerdiği aktif bileşenlerden dolayı birçok farmakolojik aktiviteye (antibakteriyal, antidiyabetik, antienflamatuar, antipiretik, antikanserojen, gastroprotektif, immünomodülator, iştah açıcı, antioksidan, kolesterol düzenleyici…vb) sahip olduğu bildirilmektedir. Çemen bitkisinden halk hekimliğinde, sindirimi kolaylaştırıcı, süt artırıcı, balgam söktürücü, ateş düşürücü, boğaz ağrısı giderici, yara iyileştirici olarak faydalanılmaktadır (Toppo ve ark., 2009; Neetu ve ark., 2011; Meghwal ve Goswami, 2012; Gökçe ve Efe, 2016).

Bütün bu özellikleri yanında çemen, ince saplı yapısı nedeniyle toprakta iyi çözünmesi, sahip olduğu uzun ve kazık kökleri ile iyi bir azot bağlayıcı olması gibi özelliklerinden dolayı toprak ıslahında etkin olarak kullanılmaktadır (Zohary ve ark., 2012; Montgomery, 2009). Bitkinin yeşil aksamı, kuru otu ve tohumları yüksek yem verimi ve besin madde içeriğinden dolayı yem bitkisi olarak da kullanılmaktadır (Manga ve ark., 2005; Meghwal ve Goswami, 2012). Çemen otunun besin madde içeriğinin, hayvan beslemede önemli bir yere sahip yonca otuna yakın olduğu, iştah açıcı özelliğinden dolayı yem tüketimini artırdığı ve canlı ağırlığı olumlu etkilediği bildirilmektedir (Acharya ve ark., 2008).

Kanatlı yemlerine katılan çemen tohumlarının bıldırcınlarda sperma kalitesini ve testis histoloji ve fizyolojik özelliklerini iyileştirebileceği, antioksidan etki gösterdiği, kan serumunda kırmızı kan hücreleri ve hemoglobin konsantrasyonlarını önemli derecede arttırdığı, beyaz kan hücreleri glikoz, kolesterol seviyelerinde, aspartat aminotransferaz ve alanin aminotransferaz enzim aktivitelerinde düşüşe sebep olduğu bildirilmiştir (Taha ve Douri, 2013; Taha, 2021). Etlik piliç yemlerine katılan çemen tohumlarının kan glikoz düzeyini arttırdığı, yem alımını ve büyüme performansını düşürdüğü (Metin ve ark., 2013; Duru ve ark., 2013) bildirilmiştir. Bunun yanında yem değerlendirme ve bağırsak etkinliğini iyileştirdiğini, protein etkinlik düzeyi, canlı ağırlık ve canlı ağırlık artışını önemli derecede
arttırdığı rapor edilmiştir (Saki ve ark., 2014; Prajapat ve ark. 2018).

Patel ve ark. (2016) tarafından yapılan çalışmada ruminantların beslenmesinde kullanılan çemen otu ve tohumlarının sahip olduğu biyoaktif bileşenler nedeniyle laktasyon performansı üzerinde önemli bir etkisi olduğu, sütün bileşimini iyileştirdiği ve süt akışını arttırdığı gösterilmiştir. Keçilerde ve koyunlarda çemen otu günlük yem alımını, süt üretimini, canlı ağırlık artışını, süt kuru maddesini, süt proteinini önemli ölçüde artırırken, yağ ve laktoz yüzdesini önemli ölçüde azalttığı bildirilmiştir. Süt ineklerinin rasyonlarına çemen otu tohumu tozu eklenmesi, kandaki bazı hematolojik ve biyokimyasal parametreleri iyileştirmiştir (Nasser ve ark., 2013).

İn vitro yöntemlerle yapılan çalışmalarda kaba yem ve yoğun yem içeren rasyonlara yem katkı maddesi olarak çemen ilavesinin rumende mikrobiyal parçalanmayı arttırdığı metan gazı oluşumunu azaltma potansiyeline sahip olduğu bildirilmiştir (Gunjan ve ark., 2008). Koyunların rasyonlarına %50 çemen otu samanının eklenmesi özellikle rumende toplam uçucu yağ asitleri (UYA) ve amonyak üretimini önemli derecede arttırmıştır (Sainil ve ark., 2017). Çemen gibi bitkilerin rasyona eklenmesinin rumen fermantasyonunu değiştirebileceği, besin madde kullanımını ve hayvan büyümesini iyileştirmek için faydalı olabileceği, metan ve amonyak salınımını engelleyebileceği öne sürülmektedir (Arhab ve ark., 2014**).** Çemen tohumlarının konsantre yem ağırlıklı beslenen ruminantların rasyonlarında katkı maddesi olarak kullanıldıklarında rumende parçalanmayı hızlandırdığı, metan gazı üretimini azalttığı, rumenden ince bağırsağa geçen bakteriyel protein miktarını arttıracağı böylece ruminantlarda verimi yükseltebileceği yönünde bildirimler de vardır (Goel ve ark., 2008).

Rasyona katılan çemen otu tohumu, farklı inkübasyon sürelerinde in vitro OM sindirilebilirliğini arttırmış HP sindirilebilirliğini azaltmıştır. KM ve NDF sindirimini toplam uçucu yağ asitleri ve gaz üretimini azaltmıştır. Sonuçta özellikle ruminant rasyonlarında kullanımının azot verimliliğini artırma potansiyeline sahip olabileceği gösterilmiştir (Naseri ve ark., 2013). Farivar ve ark. (2014) çemen otunun ruminantlar için yoncaya benzer veya daha yüksek besleme değerlerine sahip oldukça değerli bir yem olabileceğini ve rasyonlarda yonca yerine çemen otunun sorunsuzca kullanılabileceğini bildirmişlerdir. Çalışmalarda çemenin yeşil ot veriminin 883.2 ile 2156 kg/da, kuru ot veriminin 414.6 ile 430.6 kg/da'a kadar çıkabileceği bildirilmiştir (Özçelik ve Şahin, 2018; Alp, 2019).

Araştırma Van YYÜ Ziraat Fakültesi deneme arazisinde bakteri ve farklı gübre kaynakları kullanılarak farklı zamanlarda ekimi yapılan çemen (*Trigonella foenum graecum* L.*)* bitkisi kuru otunun, besin madde içerikleri ve *in vitro* sindirilebilirlik değerlerini belirlemek amacıyla yürütülmüştür.

Materyal ve Yöntem

Materyal

Denemede yem materyali olarak, Van YYÜ Ziraat Fakültesi Tarla Bitkileri bölümü işbirliği ile üniversitenin kıraç arazisinde yetiştirilen Gürarslan çemen çeşidi kullanılmıştır. Bakteri olarak, *Rhizobium meliloti* Ankara Toprak ve Gübre Araştırma Enstitüsünden temin eilmiştir. Gübre çeşitleri ise piyasadan temin edilmiştir. Bakteri uygulaması yapılacak parsellere 100 kg tohuma 1 kg *Rhizobium meliloti* bakteri kültürü, DAP (%18 N, %46 P) 15 kg/da, humik asit 65 kg/da, çiftlik gübresi ve kentsel arıtma çamuru 3 ton/da olarak

uygulanmıştır. Tohum miktarı 3.5 kg/da olarak uygulanmıştır. Çalışmada parsel büyüklüğü 3 m x 2 m = 6^2 olarak tasarlanmıştır. Deneme alanı, Van'ın kuzey doğusunda, 1727 m rakıma sahip, 38^0 25' kuzey enlemi-42^0 21' doğu boylamında ve Van Gölü'nden 2-3 km mesafede bulunmaktadır. Toprak özellikleri olarak; kireçli, tuzsuz, düşük organik içerikli, hafif alkali reaksiyona ve yeterli potasyuma sahip, orta düzeyde fosfor içerdiği görülmüştür. Vejetasyon döneminde ortalama sıcaklık15.64-17.44 ^{0}C olarak tespit edilmiştir. Ekimler, 1 Nisan ve 20 Nisan olmak üzere iki farklı dönemde yapılmıştır. Tam çiçeklenme döneminde hasat edilen örnekler kurutulmuş ve analizleri yapılmak üzere etiketlenerek muhafaza edilmiştir.

Yöntem

Denemede kullanılan yemlerin kuru madde (KM), ham kül (HK), organik madde (OM) ve ham protein (HP) içerikleri AOAC (1990) analiz sistemine göre, nötral deterjan fiber (NDF) ve asit deterjan fiber (ADF) analizleri ANKOM® lif tayin cihazı kullanılarak Van Soest ve Robertson (1979)'a göre belirlenmiştir. Yemlerin *in vitro* sindirimleri Tilley ve Terry (1963)'e göre tespit edilmiştir.

İstatistiksel analizler

Denemede elde edilen bütün veriler 4x4 Latin kare deneme desenine göre, Van YYÜ Bilgisayar Araştırma ve Uygulama Merkezinde bulunan SAS bilgisayar paket programı kullanılarak analiz edilmiştir (SAS, 2006). Ortalamalar arasındaki farklılık ise Duncan Çoklu Karşılaştırma Testi ile belirlenmiştir (Steel ve Torie, 1980).

Bulgular ve Tartışma

Tablo 1. Farklı ekim zamanı, bakteri ve gübre çeşidinin çemen otunun besin madde içeriklerine etkisi, (%).

Table 1. The effect of different planting times, bacteria and fertilizer types on the nutrient of fenugreek, (%).

	GRUPLAR	KM	OM	HP	ADF	NDF	HK
Ekim zamanı	1 Nisan	93.21±0.30	76.75±0.28	10.44±0.09b	28.79±0.27	47.44±0.70	16.26±0.31
	20 Nisan	93.72±0.07	76.84±0.28	10.95±0.15a	29.13±0.31	48.60±0.74	16.48±0.30
Bakteri	Bakterisiz	93.40±0.06a	76.46±0.27b	11.11±0.15a	28.76±0.28	48.04±0.74	16.94±0.29a
	Bakterili	93.12±0.06b	77.35±0.27a	10.28±0.08b	29.13±0.29	47.95±0.71	15.77±0.29b
Gübre	Gübresiz	93.27±0.10ab	76.45±0.45b	11.17±0.33a	29.89±0.43a	47.63±0.98ab	16.82±0.48a
	DAP	93.04±0.08b	76.96±0.38ab	10.36±0.18b	27.44±0.34c	46.40±1.18b	16.07±0.38ab
	KAÇ	93.34±0.10a	76.58±0.40b	10.41±0.15b	29.14±0.045ab	48.47±1.34ab	16.76±0.46a
	HA	93.35±0.09a	78.08±0.46a	10.97±0.20a	28.69±0.61b	50.52±1.25a	15.25±0.52b
	ÇG	93.40±0.12a	76.52±0.46b	10.62±0.11b	29.77±0.26ab	47.34±0.80ab	16.88±0.52a
E*B		0.6954	0.2722	0.0078	0.0730	0.5813	0.2548
E*G		0.0043	0.1036	<.0001	0.0970	0.0267	0.0433
E*B*G		0.1176	0.0430	<.0001	0.0048	0.8081	0.0114

Aynı sütunda farklı harfler ile gösterilen değerler arasındaki farklılık önemlidir($p<0.05$).

DAP: Di amonyum fasfat, KAÇ: Kentsel arıtma çamuru, HA: Humik asit, ÇG:Çiftlik gübresi.

E:Ekim zamanı, B:bakteri uygulaması, G: gübre uygulaması, *: interaksiyon (Pr > F)

Farklı ekim zamanı, bakteri ve gübre çeşidinin çemen otunun besin madde içeriklerine etkisi Tablo 1'de sunulmuştur. Ekim zamanı istatistiki olarak incelenen özelliklerden yalnızca HP oranını ($p<0.05$) etkilediği, diğer besin öğelerini etkilemediği belirlenmiştir. Geç yapılan ekimde protein oranı daha yüksek olmuştur ($p<0.05$). Bakteri uygulanmayan çemen otunda KM, HP ve HK oranları, bakteri uygulananlarda ise OM oranı yüksek olmuştur ($p<0.05$). Ancak bakteri uygulaması ADF ve NDF oranlarına önemli etki yapmamıştır (Tablo 1). En yüksek KM oranı kentsel arıtma çamuru, humik asit ve çiftlik gübresi uygulamalarından elde edilmiştir ($p<0.05$). En yüksek OM oranı HA uygulamasından, en yüksek HP oranı ise gübre uygulanmayan HA uygulamasından elde edilmiştir ($p<0.05$). Otun ADF içeriği gübre uygulanmayan ($p<0.05$), NDF içeriği ise HA uygulamasından elde edilmiştir ($p<0.05$). HK, oranları gübre uygulanmayan, KAÇ ve ÇG uygulamalarında yüksek olmuştur ($p<0.05$).

İkili interaksiyonlar incelendiğinde ekim zamanı ve bakteri uygulaması arasındaki interaksiyon sadece HP verimi açısından önemli olmuştur. Buna göre 20 nisanda bakteri uygulanmadan yapılan ekimde HP içerikleri yüksek olmuştur. Ekim zamanı ve gübre çeşidi arasındaki interaksiyonlar KM, HP, NDF ve kül verimi için önemli olmuştur. KM verimi açısından 20 Nisanda, KAÇ, HA ve ÇG gübreleri kullanılarak yapılan ekimlerden, HP için 20 Nisanda gübre uygulanmayan ve HA uygulanan ekimlerden, NDF için 20 Nisanda ve HA uygulaması ile yapılan ekimlerden, HK için ise yine 20 nisanda gübresiz, KAÇ ve ÇG uygulamaları ile en yüksek verimler elde edilmiştir. Üçlü interaksiyonlarda ise OM, HP, ADF ve HK verimi için önemli olmuştur. OM ve HP verimi 20 Nisanda bakteri uygulamadan, gübreşiz ve HA uygulamalarıyla, ADF için yine 20 Nisanda bakteri uygulaması ve gübresiz olarak, HK için 20 Nisanda bakterisiz, gübresiz, KAÇ ve ÇG gübreleriyle yapılan ekimlerden en yüksek verimler elde edilmiştir.

Elde edilen KM verileri genel olarak Akbay ve ark. (2020)'nın bildirmiş oldukları değerlerden daha yüksek, Özçelik ve Şahin (2018)'in tespit etmiş oldukları değerler aralığında gerçekleşmiştir. Bütün gruplarda elde edilen OM miktarları Özçelik ve Şahin (2018)'in bildirdiği değerlerden daha düşük gerçekleşmiştir. Çalışmada tespit edilen HP oranları Alp (2019) ve Akbay ve ark. (2020)'nın bildirdiği değerlerden daha düşük, ancak Özçelik ve Şahin (2018)'in bildirdiği değerler aralığında bulunmuştur. Çalışmada elde edilen ADF ve NDF değerleri bütün gruplarda Özçelik ve Şahin (2018) ile Akbay ve ark. (2020)'nın bildirdiği değerler aralığında gerçekleşmiştir. HK değerleri ise Özçelik ve Şahin (2018) ile Akbay ve ark. (2020)'nın bildirdiği değerlerden yüksek bulunmuştur. Çalışmalardan elde edilen değerlerin farklı olması; ekolojik koşulların, iklim faktörlerinin, toprak özelliklerinin ve kullanılan gübre çeşitlerinin farklı olmasından kaynaklanmış olabilir.

Farklı ekim zamanı, bakteri uygulaması ve gübre çeşidinin çemen otunun besin madde sindirimlerine etkisi Tablo 2'de verilmiştir. Ekim zamanı KMS ve HKS üzerinde etkili olmuş, 1 Nisanda ekim yapılan çemen otunun KMS ve HKS değeri 20 Nisanda ekimi yapılandan daha yüksek olmuştur ($p<0.05$). Bakteri uygulaması KMS, OMS ve HKS oranlarını arttırmıştır ($p<0.05$). Gübre uygulamalarında DAP ve ÇG uygulamaları KMS ve OMS değerlerini, HA uygulaması ise HKS değerlerini önemli derecede arttırmıştır ($p<0.05$).

İkili ve üçlü interaksiyonlar tüm sindirimler için önemli olmuştur. 1 Nisanda bakteri uygulamasıyla elde edilen kuru otların KM, OM ve HK sindirimleri yüksek olmuştur. Yine 1 Nisanda DAP ve ÇG uygulaması KM ve OM sindirimlerini, HA uygulaması ise HK

sindirimlerini yükseltmiştir. 1 Nisanda bakteri uygulaması ve ÇG uygulamasıyla KMve OM sindirimleri, HA uygulamasıyla da HK sindirimleri yükselmiştir. Çalışmada elde edilen OMS değerleri Uslu ve ark. (2018), Özçelik ve Şahin (2018) ile Akbay ve ark. (2020)'nın bildirmiş oldukları sindirim değerlerinden daha düşük bulunmuştur. Bu iki çalışmada elde edilen değerler arasındaki farklılıkların sebebi; ekolojik koşullar, kullanılan tohum çeşidi, ekimin yapıldığı bölge, biçim zamanı, toprak özellikleri, kullanılan gübre çeşidinin farklı olması sonucu kuru otun BM içeriklerinin dolayısıyla sindirim değerlerinin de farklı olmasıdır. Ayrıca farklı in vitro sindirim yöntemleri de bu farklılıkların sebebi olabilir.

Tablo 2. Farklı ekim zamanı, bakteri ve gübre çeşidinin çemen otunun besin madde sindirimlerine etkisi (%)
Table 2. The effect of different planting times, bacteria and fertilizer types on the nutrient digestion of fenugreek (%).

	GRUPLAR	**KMS**	**OMS**	**HKS**
Ekim zamanı	1 Nisan	52.43±0.88a	46.48±0.89	77.52±1.92a
	20 Nisan	50.80±0.95b	45.59±1.01	74.95±1.13b
Bakteri	Bakterisiz	48.04±090b	43.03±1.15b	70.14±1.51b
	Bakterili	55.17±0.60a	49.02±b0.60a	84.70±0.95a
Gübre	Gübresiz	49.30±1.51c	43.54±1.50b	75.37±2.32bc
	DAP	53.98±0.95a	48.86±0.86a	76.70±1.99b
	KAÇ	49.73±1.13cb	44.13±1.31b	75.39±1.56cb
	HA	51.38±1.75b	45.58±2.02b	79.98±2.16a
	ÇG	53.70±1.48a	47.97±1.15a	73.75±3.88c
E*B		0.0238	0.0003	0.0001
E*G		0.0031	0.0005	<.0001
E*B*G		0.0018	<.0001	<.0001

Aynı sütunda farklı harfler ile gösterilen değerler arasındaki farklılık önemlidir($p<0.05$).
KMS: Kuru madde sindirimi, OMS: organik madde sindirimi, HKS: Ham kül sindirimi. DAP: Di amonyum fasfat, KAÇ: Kentsel arıtma çamuru, HA: Humik asit, ÇG:Çiftlik gübresi. E:Ekim zamanı, B:bakteri uygulaması, G: gübre uygulaması, *: interaksiyon (Pr > F)

Sonuç

Çalışmadan elde edilen bulgular bir bütün olarak değerlendirildiğinde Van ve benzer ekolojilerde çemen bitkisi nisan ortasında, bakteri uygulaması yapılarak, humik asit içeren gübre kullanılması hayvan besleme açısından besin madde içerikleri görece daha iyi olan çemen otlarının elde edilebileceği söylenebilir. Elde edilen çemen otlarının *in vitro* sindirim değerleri dikkate alındığında ise 1 Nisanda ekimi yapılan çemen bitkisine bakteri uygulaması ve DAP veya ÇG gübre çeşitlerinin kullanılmasının daha iyi olacağı kanaati oluşmuştur. Bununla birlikte çemen otunun ruminant beslenmesinde kullanımının etkilerinin daha ayrıntılı olarak belirlenmesi için, kuru ot verimi, besin madde, biyoaktif madde içerikleri ve sindirimlerine yönelik *in vitro* ve *in vivo* çalışmaların yapılması gerekmektedir. Yürütülen çalışma tek yıllık olduğu için daha fazla çalışma ve uzun yıllara ait sonuçlar gerçeği daha iyi yansıtacaktır.

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Comparison of Blood Mineral Levels of Norduz Goats of Different Ages Fed on Pasture at the End of the Lactation Period

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ABSTRACT

This study was carried out to determine some makro and micro mineral levels in the blood of a total of 26 Norduz goats (at the end of 1st lactation (n=10), at the end of 2nd lactation (n=8), at the end of 3rd lactation (n=8)) fed in pasture at Van Yuzuncu Yil University, Research and Application Farm (Van, Turkiye). For this purpose, blood samples were duly taken from goats that had completed the lactation period at the beginning of June. Some macro mineral's levels (potassium (K), magnesium (Mg), calcium (Ca), sodium (Na)) and some micro mineral's levels (cobalt (Co), copper (Cu), iron (Fe), nickel (Ni), manganese (Mn), selenium (Se), zinc (Zn), lead (Pb)) in samples of serum obtained from blood samples collected from goats were determined by inductively coupled plasma optical emission spectrometry (ICP-OES). Results were subjected to all statistical analysis using SPSS 24.0 version (IBM SPSS Inc, Chicago, USA) (SPSS, 2016). All statistically significant differences ($P<0.05$) were compared and ranked with Duncan's Multiple Range Test. Later, the relationships between minerals were revealed by Pearson Correlation Coefficient ($P\leq0.05$). In addition, in this study, the ranking of macro and micro minerals and the rates of some of these minerals (Ca/Mn, Ca/Mg, Ca/Zn, Cu/Fe, Cu/Zn, Fe/Mn, Fe/Zn, K/Mg, K/Na, K/Mn) were also presented.

Laktasyon Döneminin Sonunda Merada Beslenen Farklı Yaşlardaki Norduz Keçilerinin Kan Mineral Seviyelerinin Karşılaştırılması

MAKALE BİLGİSİ

Araştırma Makalesi

Geliş: 22.08.2023
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Anahtar Kelimeler

Norduz keçisi
Kan minerali
ICP-OES
Referans değerler

ÖZ

Bu çalışma Van Yüzüncü Yıl Üniversitesi Araştırma ve Uygulama Çiftliği'nde (Van, Türkiye) merada beslenen toplam 26 Norduz keçisinin (1. laktasyon sonunda (n=10), 2. laktasyon sonunda (n=8) ve 3. laktasyon sonunda (n=8)) kanındaki bazı makro ve mikro mineral düzeylerinin belirlenmesi amacıyla yapıldı. Bu amaçla Haziran ayı başında laktasyon dönemini tamamlamış keçilerden usulüne uygun olarak kan örnekleri alındı. Keçilerden toplanan kan örneklerinden elde edilen bazı makro minerallerin düzeyleri (potasyum (K), magnezyum (Mg), kalsiyum (Ca), sodyum (Na)) ve bazı mikro minerallerin düzeyleri (cobalt (Co), bakır (Cu), demir (Fe), nikel (Ni), manganez (Mn), selenyum (Se), çinko (Zn), kurşun (Pb),) keçilerden toplanan kan örneklerinden elde edilen serum örnekleri endüktif olarak eşleşmiş plazma optik emisyon spektrometresi (ICP-OES) ile belirlendi.

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Sonuçlar SPSS 24.0 versiyonu (IBM SPSS Inc, Chicago, ABD) kullanılarak tüm istatistiksel analizlere tabi tutuldu (SPSS, 2016). İstatistiksel olarak anlamlı tüm farklılıklar ($P<0.05$) Duncan'ın Çoklu Aralık Testi ile karşılaştırıldı ve sıralandı. Daha sonra mineraller arasındaki ilişkiler Pearson Korelasyon Katsayısı ($P\leq0.05$) ile ortaya konuldu. Ayrıca bu çalışmada makro ve mikro minerallerin sıralaması ve bu minerallerden bazılarının oranları da (Ca/Mn, Ca/Mg, Ca/Zn, Cu/Fe, Cu/Zn, Fe/Mn, Fe/Zn, K/Mg, K/Na, K/Mn) sunuldu.

Introduction

Many of the minerals required in livestock (especially sheep, goat and cow) breeding are responsible for the healthy and regular functioning of the living organisms. Minerals greater than 100 ppm (parts per million) in healthy animal organisms are referred to as macro minerals, while minerals less than 100 ppm are classified as micro minerals (Anonymous, 2023a). On the other hand, those that are above 50 ppm (mg/kg) per kilogram of lean body weight are defined as macro minerals and those that are found in lower amounts are defined as microminerals. Macro minerals can be expressed as a percentage of the diet, while microminerals are expressed in ppm or sometimes ppb (parts per billion) (Anonymous, 2023b). The most well-known main 7 macro minerals (Na, K, Ca, Mg, S, P, Cl etc.) in the classification is always more than the micro minerals (Cu, Fe, Zn, Se, Mn, Fl, As, Br, Co, Cr, Li, Mo, Ni, Pb, Si, V, I etc…) are more. These minerals are in a certain amount in the body and are responsible for ensuring that the organism works in a balanced and healthy way like a machine. When the levels of minerals in the circulatory system of the organism and stored decrease; immune system, functions of enzymes, growth and fertility gradually decrease (Anonymous, 2020a). When there is a large decrease in mineral levels, clinical symptoms begin to appear. These clinical signs can sometimes reach the level that requires treatment.

Goats, which are the most used animals, especially in mountainous and unproductive lands, it comes to the forefront with the aspect of reducing the negative effects of animal husbandry on natural resources (Mutlukoca and Keskin, 2021). Also, all of analized minerals interaction of Norduz goats was presented in this study as described Jacobson et all. (1971).

Materials and Methods

26 Norduz goats, which were determined to be healthy in clinical examination that were regularly given antiparasitic drugs and vaccinated for prevent possible diseases that may occur, constituted the living material of this study. Goats that at the end of 1st lactation (n=10), at the end of 2nd lactation (n=8), at the end of 3rd lactation (n=8)) were breed at Van Yuzuncu Yil University, Small Ruminant Breeding Unit of Research and Application Farm lies on 38° 575’ North and 43° 287’ East coordinates (Van, Türkiye). The goats raised in the farm were taken to the pasture twice a day that in the morning and in the evening. These animals were not given any mineral supplementation before study.

In the first week of June, blood was duly taken from V. Jugularis from goats of different ages at the end of lactation. After that, all samples were transferred to spesific anticoagulant tubes. All of the blood samples were centrifuged at 1500×g, 10 minutes in the room temperature (68 to 72°F / 20 to 22°C) at the Laboratuar of Animal Science. After than, serum samples

transferred to Eppendorf tubes were stored at -22°C until analysis.

Dilutions of serum (1:10) with deionized water were performed as described for analysis in "standard conditions" (Harrington et al., 2014; Anonymous, 2020c). In this way, the dilution ratio provided the appropriate absorbance range required for analysis. ICP-OES (Device Brand: Thermo Scientific, Device Model: Flash 2000) is an analytical technique in which many elements are analyzed. This technique involves the excitation of the sample by the argon plasma, which is reached to a temperature of 10,000 K by electromagnetic induction, and the determination of the excited elements according to the specific wavelengths they emit. Plasma is obtained by electromagnetically stimulating argon gas with a radio frequency (RF) generator in induction windings. This happens when the hot plasma ionizes the incoming gas and the process continues continuously. Results were measured and presented as ppm.

The results of the minerals obtained from this study were subjected to statistical analysis using SPSS 24.0 version (IBM SPSS Inc, Chicago, USA) (SPSS, 2016). All statistically significant differences ($P<0.05$) were compared and ranked with Duncan's Multiple Range Test. Later, the relationships between minerals were revealed by Pearson Correlation Coefficient ($P\leq0.05$). In addition, in this study, the ranking of macro and micro minerals and the rates of some of these minerals (Ca/Mn, Ca/Mg, Ca/Zn, Cu/Fe, Cu/Zn, Fe/Mn, Fe/Zn, K/Mg, K/Na, K/Mn) were also presented. Minerals ranking of Norduz goats was made according to ppm levels (Patkowska-Sokola et al., 2009).

Results

In this presented study, minimum-maximum (min-max) and mean concentration ± standard error (x±Sx) of serum macro and micro mineral values belonging to Norduz goats that at the end of 1st, 2nd and 3rd lactation were presented in Table 1 and Table 2, respectively. According to these results, the blood mineral levels at the total group (∑) of Norduz goats were detected as K 177.323±6.386 ppm, Mg 14.497±0.815 ppm, Ca 40.306±2.263 ppm, Na 1879.850±57.810 ppm for makro minerals and Co 0.007±0.000 ppm, Cu 0.0674±0.0616 ppm, Fe 1.425±0.079 ppm, Ni 0.009±0.004 ppm, Mn 1.371±0.048 ppm, Se 0.759±0.028 ppm, Zn 0.632±0.033 ppm, Pb 0.016±0.001 ppm for micro minerals. A statistical significance (≤0.05) was determined between the three groups for K, a macro-mineral; a non-significant difference (>0.05) was found for Mg, Ca and Na.

Table 1. Serum macro minerals

Tablo 1. Serum makro mineraller

		At the end of 1st lactation	At the end of 2nd lactation	At the end of 3rd lactation	∑
K	N	10	8	8	26
	Min-Max	163.500-265.900	129.900-220.800	108.800-235.100	108.800-265.900
	X	196.550[a]	162.113[b]	168.500[ab]	177.323
	sX	8.739	9.105	12.548	6.386
	P		*		
Mg	N	10	8	8	26
	Min-Max	9.227-23.690	8.783-22.900	7.294-18.710	7.294-23.690
	X	15.495	15.505	12.243	14.497
	sX	1.247	1.578	1.297	0.815
	P		NS		
Ca	N	10	8	8	26
	Min-Max	25.440-66.170	22.040-53.700	20.830-50.140	20.830-66.170
	X	41.778	41.271	37.501	40.306
	sX	4.348	4.249	3.057	2.263
	P		NS		
Na	N	10	8	8	26
	Min-Max	1664.000-2624.000	1425.000-2320.000	1205.000-2051.000	1205.000-2634.000
	X	2040.600	1768.880	1789.880	1879.850
	sX	85.538	96.591	100.857	57.810
	P		NS		

NS: Non significant; *≤0.05; Letters of a, ab, b represent the Duncan order from uppercase to lowercase.

Table 2. Serum micro minerals
Tablo 2. Serum mikro mineraller

		At the end of 1st lactation	At the end of 2nd lactation	At the end of 3rd lactation	∑
Co	N	10	8	8	26
	Min-Max	0.005-0.010	0.004-0.010	0.004-0.010	0.004-0.010
	X	0.007	0.007	0.007	0.007
	sX	0.001	0.001	0.001	0.000
	P		NS		
Cu	N	9	8	8	25
	Min-Max	0.354-1.437	0.094-0.979	0.267-1.179	0.094-1.437
	X	0.639	0.595	0.791	0.674
	sX	0.113	0.105	0.101	0.616
	P		NS		
Fe	N	10	8	8	26
	Min-Max	1.053-2.559	0.546-2.123	0.982-1.728	0.546-2.559
	X	1.514	1.422	1.318	1.425
	sX	0.152	0.1570	0.097	0.079
	P		NS		
Ni	N	4	4	6	14
	Min-Max	0.003-0.054	0.001-0.008	0.002-0.017	0.001-0.054
	X	0.018	0.005	0.006	0.009
	sX	0.024	0.002	0.002	0.004
	P		NS		
Mn	N	10	8	8	26
	Min-Max	1.299-2.297	0.944-1.723	1.120-1.453	0.944-2.297
	X	1.502	1.299	1.280	1.371
	sX	0.091	0.081	0.045	0.048
	P		NS		
Se	N	10	8	8	26
	Min-Max	0.714-1.217	0.473-1.012	0.557-0.839	0.473-1.217
	X	0.835	0.694	0.729	0.759
	sX	0.045	0.057	0.033	0.028
	P		NS		
Zn	N	7	8	7	22
	Min-Max	0.377-0.773	0.452-0.862	0.524-0.924	0.038-0.924
	X	0.552	0.657	0.683	0.632
	sX	0.057	0.054	0.053	0.033
	P		NS		
Pb	N	10	6	8	24
	Min-Max	0.008-0.017	0.005-0.030	0.011-0.032	0.005-0.032
	X	0.013	0.020	0.018	0.016
	sX	0.001	0.003	0.003	0.001
	P		NS		

NS: Non significant

Correlation tables of blood macro and micro minerals of Norduz goats at the end of the 1st, 2nd and 3rd lactations were presented in Table 3, Table 4 and Table 5, respectively. In pearson correlation analysis of mineral levels of goats at the end of the 1st lactation, positive statistical significance (positive correlation) (≤0.05) were calculated between Ca-Cu, Ca-Mg, Ca-Mn, Ca-Se, Cu-Na, Mg-Na, Mg-Se, Na-Ni; positive high correlation was founded. statistical significance (≤0.01) were calculated between Ca-Na, Cu-Mg, Cu-Se, Fe-K, K-Mn, K-Na, K-Se, K-Na, K-Se, Mg-Mn, Mn-Na, Mn-Ni, Na-Se; positive very high statistical significance (≤0.001) were calculated between K-Mn, Mn-Se and negative high statistical significance (≤0.01) were calculated between Na-Zn. In pearson correlation analysis of mineral levels of goats at the end of the 2nd lactation, positive statistical significance (≤0.05) were calculated between Ca-Fe, Ca-Mg, Ca-Mn, Cu-Fe, Cu-K, Cu-Na, Cu-Se, Fe-Zn, Mg-Zn, Mn-Zn; positive high statistical significance (≤0.01) were calculated between Fe-K, Fe-Na, Fe-Se, K-Mn, K-Se, Na-Se; positive very high statistical significance (≤0.001) were calculated between Ca-Zn, Fe-Mn, K-Na, Mn-Se. In pearson correlation analysis of mineral levels of goats at the end of the 3rd lactation, positive statistical significance (≤0.05) were calculated between Ca-Mn, Ca-Na, Ca-Se, Fe-K, Fe-Na, Mg-Na, Na-Se, Pb-Zn; positive high statistical significance (≤0.01) were calculated between K-Na, Mn-Se. The other hand, correlation table of blood macro and micro minerals of all Norduz goats (∑) were presented in Table 6. In pearson corelation coefficient of mineral levels of at the end of the lactation, positive statistical significance (≤0.05) were calculated between Ca-Cu, Ca-K, Co-Mn, Cu-K, Cu-Mg, Cu-Ni, Mg-Ni, Mg-Se, Na-Ni; positive high statistical significance (≤0.01) were calculated between Ca-Fe, Co-Se, Cu-Mn, Cu-Na, Cu-Se, Fe-Mg, Fe-Ni, K-Mg, K-Ni, Mg-Na, Ni-Se, Pb-Zn; positive very high statistical significance (≤0.001) were calculated between Ca-Mg, Ca-Mn, Ca-Na, Ca-Se, Cu-Fe, Fe-K, Fe-Mn, Fe-Na, Fe-Se, K-Mn, K-Na, K-Se, Mg-Mn, Mn-Na, Mn-Ni, Mn-Se, Na-Se.

Table 3. Pearson Corelation Coefficients of mineral levels of goats at the end of the 1st lactation
Tablo 3. 1. Laktasyon sonundaki keçilerin mineral düzeylerinin Pearson Korelasyon Katsayıları

	Ca	Co	Cu	Fe	K	Mg	Mn	Na	Ni	Pb	Se	Zn
Ca	1.000 10	0.122 10	**0.664** 9	0.491 10	0.52510	**0.732*** 10	**0.691*** 10	**0.814**** 10	0.7864	0.510 10	**0.681*** 10	-0.5657
Co		1.000 10	0.2619	0.080 10	-0.00410	0.36510	0.40410	0.01810	0.9384	-0.064 10	0.37110	0.1927
Cu			1.0009	0.774 9	0.7609	**0.807**** 9	**0.862**** 9	**0.708*** 9	0.9004	0.333 9	**0.838**** 9	0.2417
Fe				1.000 10	**0.788**** 10	0.50810	**0.827**** 10	**0.745**** 10	0.9444	-0.091 10	**0.855**** 10	-0.3757
K					1.00010	0.60710	**0.859**** 10	**0.824**** 10	**0.973*** 4	0.332 10	**0.833**** 10	-0.3527
Mg						1.00010	**0.778**** 10	**0.726*** 10	0.8464	0.557 10	**0.709*** 10	-0.0777
Mn							1.00010	**0.852**** 10	**0.992**** 4	0.273 10	**0.986***** 10	-0.6707
Na								1.00010	**0.956*** 4	0.304 10	**0.853**** 10	**-0.899**** 7
Ni									10004	0.443 4	0.9814	1.0002
Pb										10004	0.17810	0.3917
Se											1.00010	-0.7317
Zn												10007

*≤0.05 ** ≤0.01 ***≤0.001

Table 4. Pearson Corelation Coefficients of mineral levels of goats at the end of the 2nd lactation
Tablo 4. 2. Laktasyon sonundaki keçilerin mineral düzeylerinin Pearson Korelasyon Katsayıları

	Ca	Co	Cu	Fe	K	Mg	Mn	Na	Ni	Pb	Se	Zn
Ca	1.0008	0.2578	0.3998	**0.809**8	0.6298	**0.698**8	**0.778***8	0.6158	-0.07948	-0.1926	0.5728	**0.918****8
Co		1.0008	0.0938	0.4518	0.4988	-0.4108	0.6178	0.5748	0.5754	-0.6616	0.6498	0.1318
Cu			1.0008	**0.761**8	**0.737***8	0.3948	0.6568	**0.781***8	-0.21548	0.0976	**0.725***8	0.4458
Fe				1.0008	**0.861****8	0.5098	**0.964*****8	**0.895****8	-0.33748	-0.3536	**0.909****8	**0.736***8
K					1.0008	0.3728	**0.882****8	**0.919*****8**	-0.48848	0.0226	**0.905****8	0.6958
Mg						1.0008	0.4088	0.2988	-0.31748	0.4896	0.2568	**0.781***8
Mn							1.0008	0.914008	-0.20548	-0.4526	**0.958*****8	**0.729***8
Na								1.0008	0.0674	-0.16466	**0.933*****8	0.5718
Ni									1.0004	-0.67533	-0.4244	-0.1214
Pb										1.0006	-0.4036	0.0386
Se											1.0008	0.5648
Zn												1.0008

*≤0.05 ** ≤0.01 ***≤0.001

Table 5. Pearson Corelation Coefficients of mineral levels of goats at the end of the 3rd lactation
Tablo 5. 3. Laktasyon sonundaki keçilerin mineral düzeylerinin pearson korelasyon katsayıları

	Ca	Co	Cu	Fe	K	Mg	Mn	Na	Ni	Pb	Se	Zn
Ca	1.0008	0.3088	0.5308	0.2828	0.3778	0.5518	**0.770*** 8	**0.718*** 8	-0.04866	0.18688	**0.789*** 8	0.1147
Co		1.0008	-0.3178	-0.6758	-0.5208	-0.3128	0.3508	-0.1618	0.72866	0.48288	0.4818	0.4917
Cu			1.0008	0.6688	0.3088	0.6678	0.6428	0.5938	-0.15996	-0.22388	0.4218	-0.3367
Fe				1.0008	**0.800*** 8	0.6918	0.2638	**0.739*** 8	-0.37886	-0.15008	0.2278	-0.4827
K					1.0008	0.6658	0.1608	**0.825*** 8	-0.17736	0.17388	0.2628	-0.347
Mg						1.0008	0.6688	**0.776*** 8	0.09766	0.06888	0.4848	0.2317
Mn							1.0008	0.6608	0.23766	0.38188	**0.904*** 8	0.3477
Na								1.0008	0.02666	0.39788	**0.735*** 8	0.1527
Ni									1.00066	0.55866	0.2266	0.7255
Pb										1.0008	0.6278	**0.762*** 7
Se											1.0008	0.4607
Zn												1.0007

*≤0.05 ** ≤0.01 ***≤0.001

Table 6. Pearson Corelation Coefficients of mineral levels of all goats (∑) at the end of the lactation

Tablo 6. Laktasyon sonundaki tüm keçilerin (∑) mineral düzeylerinin Pearson Korelasyon Katsayıları

	Age	Ca	Co	Cu	Fe	K	Mg	Mn	Na	Ni	Pb	Se	Zn
Age	1.000 26	-0.152 26	-0.043 26	0.202 25	-0.203 26	**-0.382*** 26	-0.319 26	**-0.392*** 26	-0.373 26	-0.353 14	0.337 24	-0.328 26	0.350 22
Ca		1.000 26	0.196 26	**0.460*** 25	**0.576**** 26	**0.461*** 26	**0.679***** 26	**0.691***** 26	**0.674***** 26	0.516 14	0.168 24	**0.610***** 26	0.308 22
Co			1.000 26	0.059 25	0.064 26	0.027 26	-0.124 26	**0.440*** 26	0.019 26	0.508 14	-0.128 24	**0.505**** 26	0.228 22
Cu				1.000 25	**0.6445***** 25	**0.463*** 25	**0.466*** 25	**0.593**** 25	**0.561**** 25	**0.601*** 14	0.042 23	**0.596**** 25	0.243 22
Fe					1.000 26	**0.731***** 26	**0.552**** 26	**0.791***** 26	**0.752***** 26	**0.669**** 14	-0.158 24	**0.756***** 26	0.095 22
K						1.000 26	**0.511**** 26	**0.717***** 26	**0.875***** 26	**0.699**** 14	-0.068 24	**0.734***** 26	0.030 22
Mg							1.000 26	**0.604***** 26	**0.572**** 26	**0.467*** 14	0.232 24	**0.452*** 26	0.356 22
Mn								1.000 26	**0.831***** 26	**0.846***** 14	-0.126 24	**0.950***** 26	0.186 22
Na									1.000 26	**0.596*** 14	-0.035 24	**0.864***** 26	-0.064 22
Ni										1.000 14	-0.022 13	**0.744**** 14	0.390 11
Pb											1.000 24	-0.117 24	**0.549**** 20
Se												1.000 26	0.157 22
Zn													1000 22

*≤0.05 ** ≤0.01 ***≤0.001

The macro and micro minerals whose levels were determined for ranked from largest to smallest in Table 7. The order of the first 6 minerals (Na, K, Ca, Mg, Fe, Mn) was the same in all groups. For the other 6 minerals (Se, Zn, Cu, Pb, Ni, Co) there were differences in the ordering of the groups.

Table 7. Ranking of macro and micro minerals
Tablo 7. Makro ve mikro minerallerin sıralaması

	1	2	3	4	5	6	7	8	9	10	11	12
At the end of 1st lactation	Na	K	Ca	Mg	Fe	Mn	Se	Cu	Zn	Ni	Pb	Co
At the end of 2nd lactation	Na	K	Ca	Mg	Fe	Mn	Se	Zn	Cu	Pb	Co	Ni
At the end of 3rd lactation	Na	K	Ca	Mg	Fe	Mn	Cu	Zn	Se	Pb	Co	Ni
∑	Na	K	Ca	Mg	Fe	Mn	Se	Zn	Cu	Pb	Ni	Co

The proportional values of macro and micro minerals that had a proportional relationship with each other according to the literature (Jacobson et all., 1971) were presented in Table 8. The rates of macro and micro minerals were determined for Na/K, K/Mg, K/Mn, Ca/Mg, Ca/Mn, Ca/Zn, Fe/Mn, Fe/Zn, Fe/Cu, Cu/Zn.

Table 8. Rates of some macro and micro minerals
Tablo 8. Bazı makro ve mikro minerallerin oranları

	Na/K	K/Mg	K/Mn	Ca/Mg	Ca/Mn	Ca/Zn	Fe/Mn	Fe/Zn	Fe/Cu	Cu/Zn
At the end of 1st lactation	10.382	12.685	130.859	2.696	27.815	75.685	1.008	2.743	2.369	1.158
At the end of 2nd lactation	10.911	10.456	124.798	2.662	31.771	62.817	1.095	2.164	2.390	0.906
At the end of 3rd lactation	10.622	13.770	131.641	3.063	29.298	54.906	1.030	1.930	1.666	1.158
∑	10.601	12.232	129.338	2.780	29.399	63.775	1.039	2.255	2.114	1.066

Discussion and Conclusion

Goats are a species rich in racial diversity. Studies are being carried out on the blood biochemistry and mineral values of these breeds. However, there is still not enough literature available on the basis of race. For this reason, in many studies, the discussion section is made by taking into consideration the literature of different races.

According to the results of a study conducted by Altuğ et al (2013); Na and K levels in goats with chronic fluorosis were determined as 142.1±11.5 mEq/L and 5.30±0.55 mEq/L, respectively. In this study, measured Na and K levels (1879.850±57.810 ppm and 177.323±6.386 ppm) lower than the values reported by Altuğ et al., (2013).

In a study investigated mineral levels in Honamlı goats, Demir et al. (2020) determined serum Ca and Mg levels as 6.786±0.206 mg/dL and 2.161±0.05 mg/dL, respectively. An another study conducted by Altuğ et al., (2013) Ca and Mg levels of goats were determined as 8.85±0.58 mg/dL and 2.62±0.10 mg/dL, respectively. In a study in which they investigated the hematobiochemical values and mineral status of Chegu Pashmina goats, Katoch et al. (2020) reported that Ca and Mg levels were as 10.14±0.412 mg/dl and 3.50±0.14 mg/dl, respectively, In this study, measured Ca and Mg levels (40.306±2.263 ppm and 14.497±0.815 ppm) lower than the values reorted by Demir et al. (2020), Altuğ et al., (2013) and Katoch et al. (2020). On the other hand, Sovende et al. (2008) reported the blood mineral Ca level of Wad goats grazing in natural pastures as 5.39±0.21 mmol/L. However, the value reported by Sovende et al. (2008) was much lower than the Ca level of this study.

Yatoo et al. (2013) reported that blood Cu, Zn and Fe levels of goats were 0.548±0.094 mg/L, 0.864±0.211 mg/L and 1.548±0.173 mg/L, respectively. In addition, Fathy Nawito et al. (2015) reported Cu, Zn and Fe levels of non-pregnant goats raised in South Sinai, Egypt as 0.49±0.05 ppm, 4.65±0.24 ppm and 4.91±0.09 ppm, respectively. In a study conducted by Altuğ et al., (2013), blood Cu, Zn and Fe levels of animals in the control group was determined as 0.550±0.05 mg/L, 0.574±0.08 mg/L and 1.245±0.03 mg/L, respectively. In another study conducted by Demir et al., (2020) investigating serum mineral levels in Honamlı goats, mineral Fe level was determined as 110.706±2.510 µg/dL. The Fe level measured in this study (1.425±0.079 ppm) was close to the reported value by Yatoo et al. (2013), Altuğ et al., (2013) and Demir et al., (2020) but less than reported by Fathy Nawito et al. (2015).

At a study conducted by Altuğ et al., (2013) Mn and Ni were determined as 0.0186±0.02 mg/L and 0.166±0.01 mg/L, respectively. The Mn level measured in this study (1.371±0.048 ppm) was very higher than Altuğ et al., (2013)'s result. But, Ni level measured in this study (0.009±0.004 ppm) was very lower than Altuğ et al., (2013)'s result. The other hand, in a study from Katoch et al. (2020) Co level was determined as 0.18±0.01 ppm. The Co level measured in this study (0.007±0.000 ppm) was very lower than Katoch et al. (2020)'s result.

Pechová et al. (2015) reported the blood Se levels of newly weaned kids and 4-week-old kids as 141.0 ± 35.7 µg/L and 124.0 ± 29.1 µg/L, respectively. The other, as a result of a study conducted by Pavlata et al. (2011) the mean Se concentrations in the blood of the goats in the control group at the beginning of the study were reported as 109.6 ± 34.3 µg/L. The Se level measured in this study (0.759±0.028 ppm) was very higher than Pechová et al. (2015) and Pavlata et al. (2011)'s result.

Blood Pb levels were investigated in goats raised in areas close to primary pollution areas caused by Pb-Zn, an ecological pollutant (Swarup et al., 2006). As a result of the same research, the blood Pb average of the goats in the control group was 0.015±0.015 µg/ml; in goats raised in the vicinity of drinking water, which is thought to be contaminated due to contact with metal wastes, the mean Pb was reported as 0.373±0.093 µg/ml. In another study investigating high doses of Pb in the blood, the blood Pb levels of Red Sokoto goats freely grazing on open pastures in Zaria ranged from 0.26 mg/L to1.56 mg/L, while the mean Pb level

was reported as 0.89±0.43 mg/L. According to the results of the same study, it was reported that as Red Sokota goats were freely grazed in Zaria, the blood Pb level exceeds the permissible limit for health and therefore was not safe for human consumption (Ugumanim et al., 2015). In a study conducted by Altuğ et al., (2013) in goats with chronic fluorosis, blood Pb serum value of animals in the control group was determined as 0.109±0.03 mg/L. The Pb level measured in this study (0.016±0.001 ppm) was determined by Swarup et al. (2006) was close to the reported value. And Ugumanim et al. (2015) reported that it was below the permissible toxic limit for health. Therefore, blood Pb levels of Norduz goats in this study were within the limits specified in the relevant literature. But, the Pb results of this study were significantly lower than the value reported by Altuğ et al. (2013).

In the literature review, it was seen that the biochemical and hematological studies conducted in Norduz Goats were insufficient. However, the macro and micro mineral values of these animals are closely related to nutrition, reproduction and diseases. Especially during the lactation period, it is expected that the decreasing mineral stores will be renewed and the body will be ready for a new pregnancy in a healthy way after collecting itself. This is only possible if the reference values of healthy goats at the end of lactation are known. In this respect, it is thought that this study is very important in terms of being a reference for future studies. This study is thought to be important in terms of being a reference in determining the blood mineral levels of Norduz goats at the end of lactation. Moreover, as a result of this study, since the results of Mn, Ni and Co were highly different from the literature reports, it is thought that these minerals should be investigated more comprehensively in Norduz goats.

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Calf Rearing Practices in the Northeast Anatolian Region of Türkiye: A Case of Horasan County of Erzurum Province

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ABSTRACT

The aim of this study was to assess calf rearing methods applied in 500 cattle farms in the Horasan district of Erzurum province. Data used in this study were obtained through face-to-face interviews with cattle breeders. In 69.5% of the enterprises operating within Horasan county, the exact quantity of milk consumed by calves could not be determined due to the fact that they are fed by nursing from their mothers. On the other hand, the proportions of farms feeding calves 1, 2, 3, 4, 5 and 6 liters of milk per day were determined as 0.4%, 0.6%, 5.7%, 3.6%, 8.9%, and 11.3%, respectively. In 38.4% of cattle enterprises in the county, calves were fed with milk while their mothers were being milked, whereas in 27.6% of cattle farms, calves were weaned at 4 months of age, and in 24.3% at 5 months. Furthermore, it was also observed that the most of breeders (72.7%) considered the birth weight of calves as a criterion to decide on the quantity of milk to be provided to them. On these farms, the methods of feeding colostrum to calves were by sucking their mothers with a percentage of 54.3%, followed by bottle feeding with a percentage of 45.5% and the bucket method with a very low percentage of 0.2%. Furthermore, calves in Horasan County usually begin to be given calf starter feed either at the age of 2 weeks (28.3%) or 3 weeks (28.1%), while dry hay is generally introduced to the most of calves (42.0%) at the age of 2 weeks. In conclusion, some inaccuracies in calf rearing practices were identified in Horasan county of Erzurum province and solutions were proposed to address these problems.

Türkiye'nin Kuzeydoğu Anadolu Bölgesinde Buzağı Yetiştirme Uygulamaları: Erzurum İli Horasan İlçesi Örneği

MAKALE BİLGİSİ

Araştırma Makalesi

Geliş: 26.10.2023
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ÖZ

Bu çalışmanın amacı, Erzurum ilinin Horasan ilçesinde faaliyet gösteren 500 sığırcılık işletmesinde uygulanan buzağı yetiştirme yöntemlerini değerlendirmektir. Çalışmada kullanılan veriler, sığır yetiştiricileri ile yüz yüze yapılan anketler yoluyla elde edilmiştir. Horasan ilçesinde faaliyet gösteren işletmelerin %69,5'inde buzağılar annelerinden süt emerek beslendikleri için buzağıların tükettikleri süt miktarı net olarak tespit edilememiştir. Öte yandan, buzağıları günde 1,

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Anahtar Kelimeler

Buzağılar
Sütten kesim
Kolostrum
Buzağı başlatma yemi
Erzurum

*** Sorumlu Yazar**

mtyanar@gmail.com

2, 3, 4, 5 ve 6 litre sütle besleyen işletmelerin oranları sırasıyla %0,4, %0,6, %5,7, %3,6, %8,9 ve %11,3 olarak belirlenmiştir. İlçedeki sığırcılık işletmelerinin %38,4'ünde buzağılar anneleri sağıldığı süreçte sütle beslenirken, sığırcılık işletmelerinin %27,6'sında buzağılar 4 aylıkken, %24,3'ünde ise 5 aylıkken sütten kesilmektedir. Ayrıca, yetiştiricilerin çoğunluğunun (%72,7) buzağılara verilecek süt miktarına karar vermek için buzağıların doğum ağırlığını bir kriter olarak kabul ettiği de gözlemlenmiştir. Bu çiftliklerde buzağılara kolostrum verme yöntemi olarak %54,3'lük bir oranla annelerini emme yöntemi kullanılırken, bunu %45,5'lik bir oranla biberonla besleme ve %0,2'lik çok düşük bir oranla kova yöntemi takip etmiştir. Ayrıca, Horasan ilçesindeki buzağılara genellikle 2 haftalık (%28,3) veya 3 haftalık (%28,1) yaşta buzağı başlangıç yemi verilmeye başlanırken, kuru saman buzağıların çoğuna (%42,0) genellikle 2 haftalık yaşta verilmektedir. Sonuç olarak, Erzurum ili Horasan ilçesinde buzağı yetiştirme uygulamalarında yapılan yanlışlıklar belirlenmiş ve bu sorunların giderilmesi için çözüm önerileri sunulmuştur.

Introduction

Cattle play a major role in the worldwide production of meat and milk, including in Turkey. According to the latest FAO data, the global number of cattle has exceeded 1.529 billion in 2021, making them one of the most commonly reared types of livestock worldwide (Anonymous, 2023).

The hilly terrain, high altitude, and plentiful pastures and meadows, along with unsuitable climatic conditions for cultivating industrial and horticultural crops, have made animal husbandry, primarily cattle rearing, a crucial economic activity in Erzurum province. According to the latest livestock statistics, the province has reared 800,002 head of cattle in the year 2022. In the province, 19.05% of the cattle were continental breeds, while crossbreeds made up 76.63% and indigenous breeds 4.32% (Anonymous, 2023). Furthermore, Horasan county contributed 8.52% of the total number of cows in Erzurum province.

Calf rearing is a vital factor in ensuring the sustainability of cattle enterprises, and it is an area of cattle rearing that demands the utmost attention (Kaygısız et al., 2023). Obtaining one calf annually from each cow is crucial for profitability in dairy cattle breeding (Özhan et al., 2015). The continuity of the herd depends on a successful and healthy calf breeding programme. Therefore, it is imperative to minimize calf losses, particularly during the neonatal period. Raising healthy calves is very important in order to replace the cows that are culled from the herd every year for various reasons with new breeding cows (Tüzemen and Yanar, 2013). In calf rearing systems, factors that negatively affect calf health include inadequate and poor calf feeding, insufficient and poor quality colostrum intake, poor housing conditions and inadequate health protection programs. Furthermore, high calf mortality rates around the world are also considered to be the most important parameters indicating poor animal welfare and herd management (Kaygısız et al., 2022).

When conducting surveys to identify the current situation and problems in livestock enterprises, it is important to collect information on recent production, farm management and enterprise practices (Costa et al., 2013). This information can also be crucial for designing livestock policies for a region or even an entire country (Koçyiğit et al., 2023). Although numerous survey studies have been conducted on calf rearing techniques, problems and

proposed solutions in different regions of Turkey (Oğuz et al., 2013; Koçyiğit et al., 2015; Yener and Yaylak, 2015; Diler et al., 2017; Kaylan et al., 2019; Karaca, 2020; Kurt 2020; Sezer, 2020; Özsağlıcak and Yanar, 2021; Ermetin and Erkan Can, 2023), there is no study conducted in Horasan county of Erzurum province. Therefore, the aim of this research is to evaluate the current management approaches of calf rearing in cattle farms in Horasan county, highlight the existing problems and provide recommendations for these problems.

Material and Method

The study was approved by Atatürk University Faculty of Agriculture Ethics Committee Chairmanship (Protocol Number: 2023/11). Data used in this study were obtained by conducting a face-to-face survey of cattle farms located in 77 villages in the county of Horasan in the province of Erzurum. For the purpose, 500 farm owners selected from 4565 farms in the county were interviewed. In the determination of the random sample size (number of enterprises) in this research, a method whose formula is given below, was used. This formula is for cases where the variance is unknown, the population is limited and there are qualitative variables dependent on probability (Arıkan, 2007).

$$n= (N.\ Z^2_{\alpha/2}.\ p.\ q)/[(N-1).\ D^2]+(\ Z^2_{\alpha/2}.\ p.\ q)$$

In this formula;
n=Number of samples,
N=Population size,
D=Margin of error (5%),
$Z_{\alpha/2}$= Table value (1.96) for α= 0.05,
p=The rate to be calculated (0.5),
q=1-p.

$$n = \frac{4565*1.96^2* 0.5*0.5}{(4564*0.05^2)+(1.96^2*0.5*0.5)} =354.6$$

The study initially established a minimum of 355 surveys, which was later increased by 41.0%. A survey was then conducted with 500 owners of enterprises in Horasan county. The data collected from the survey was transferred to Excel 2016 and analyzed using the SPSS statistical software package (SPSS, 2013) through frequency analyses.

Results and Discussion

Daily amount of milk given to the calves

The results concerning the daily amount of milk given to the calf and the age at weaning are presented in Figure 1. In response to the question of the amount of milk given to the calf daily, 69.5% of the farmers preferred the option as much as the calf suckled. This was followed by 4 liters with 11.3%, 5 liters with 8.9%, 3 liters with 5.7%, 2 liters with 3.6%, 6 liters with 0.6% and 1 liters with 0.4%. Among the results of studies conducted in other regions of Turkey, Kaygısız et al. (2023) showed that 66% of cattle breeders in Torul county of Gümüşhane province gave more than 5 kg of milk to calves in the first 30 days, while 76% gave less than 5 kg of milk in 31-60 days. Similarly, Koçyiğit et al. (2021) reported that the majority (44.2%)

of cattle enterprises in the central county of Ağrı province offered 5 litres of milk per day to calves, while in 34.0%, 11.3%, 8.3% and 2.0% of cattle farmers gave daily 4 litres, 6 litres or more, 3 litres and 2 litres of milk to calves, respectively. However, Tatar and Esenbuğa (2022) stated that 70% of cattle farmers in Ödemiş county of İzmir province gave 1-3 litres of milk and 27.1% gave 4-5 litres of milk to calves in the first weeks.

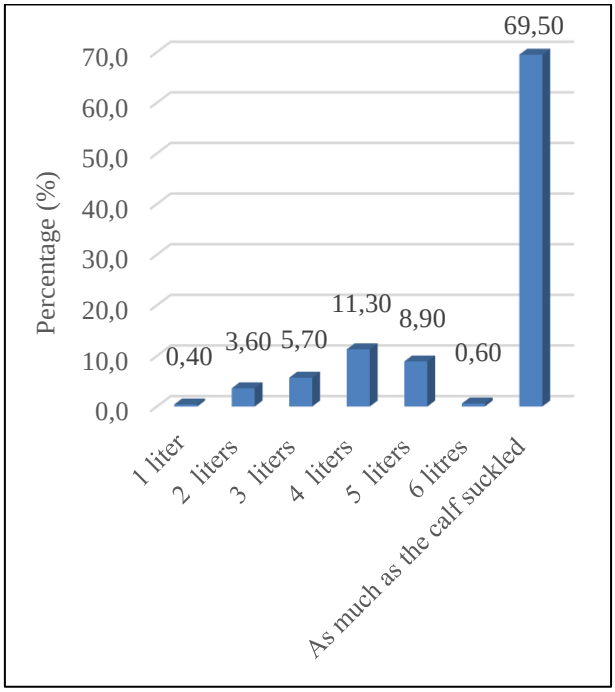

Figure 1. Daily amount of milk given to the calves (kg)
Şekil 1. Buzağılara günlük verilen süt miktarı (kg)

Weaning age of the calves

Calf weaning is a critical and challenging procedure in livestock breeding that significantly influences calf welfare, development, and growth. In dairy cow production systems across USA and Canada, economic considerations have caused the pre-weaning period to be shortened to 6-8 weeks of age. Although the age of calf differs significantly between cattle farms in Turkey, Erez and Göncü (2012) report that it is later than in the USA and European countries. In terms of the age at which calves were weaned in Horasan county of Erzurum province, 38.4% of owners of enterprises responded that calves were suckled for as long as their mothers were milked. This was followed by 4 months with 27.6%, 5 months with 24.3%, 6 months with 4.7%, 3 months with 2.8%, 7 months with 1.4%, 2 months with 0.6% and 1 months with 0.2% (Figure 2). Thus, the average weaning age of the calves reared in Horasan county of Erzurum province was found to be between 3 and 4 months of age. Similarly, Kaygısız et al. (2008) reported that 56.0% of the cattle farms in Kahramanmaraş province weaned their calves at 3-4 months, while Öztürk (2009) found that calves in Mardin province were fed milk for more than 3 months. Furthermore, Özsağlıcak and Yanar (2021) reported that the majority (79.7%) of calves reared in the central county of Erzincan province were weaned at the age of 3-4 months, while Yeşil (2015) found that 61.5% of calves were weaned at the age of 3-4 months and 39.5% at the age of 5 months in Iğdır province. Furthermore, Koçyiğit et al. (2021) also stated that the majority (58.0%) of cattle breeders in Ağrı province weaned their calves at

6 months of age. In contrast to the results of the above studies, Akkuş (2009) found that the average weaning age of calves reared in Konya province was 68.3 days.

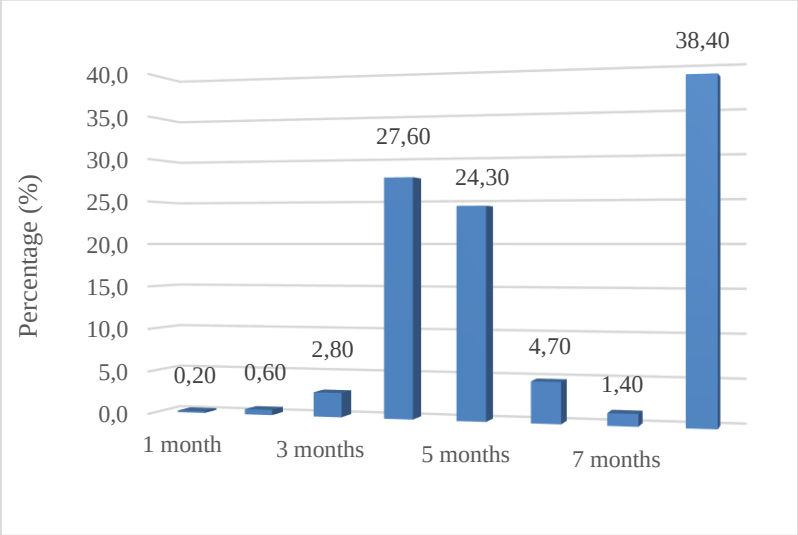

Figure 2. Weaning age of the calves
Şekil 2. Buzağıların sütten kesim yaşları

Criteria used to determine the amount of milk to be given to calves

The results of the criteria considered by the cattle breeders in Horasan to determine the amount of milk to be given to the calves are presented in Figure 3. Although the majority of farmers (72.7%) used birth weight as a criterion to determine the amount of milk to be given to the calf, 18.4% reported that they adjusted the amount of milk according to the age of the calf and 3.2% according to live weight. A further 5.7% of breeders reported that the amount of milk to be given to the calf was determined randomly and no criteria were taken into account. Contrary to the findings obtained in the present study, Koçyiğit et al. (2021) reported that the majority (86.8%) of cattle breeders in the province of Ağrı Province determined the amount of milk to be given to their calves randomly and roughly without considering any criteria.

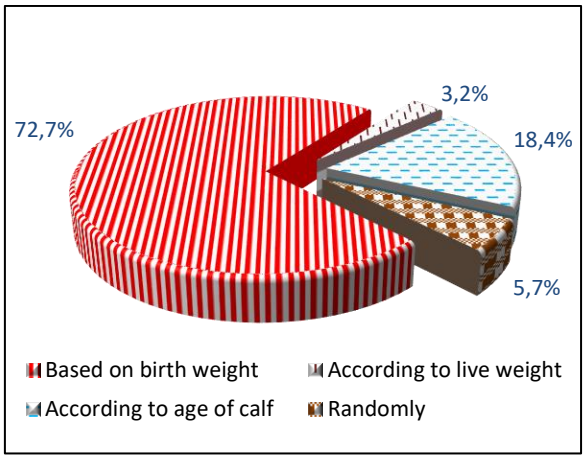

Figure 3. Criteria used for determining the amount of milk to be given to calves
Şekil 3. Buzağılara verilecek süt miktarını tespit etmek için kullanılan kriterler

Colostrum feeding methods and umbilical cord care for newborn calves

The results of the methods of feeding colostrum to calves reared on cattle farms in Horasan County are presented in Figure 4. In these farms, the methods of feeding colostrum to calves were by suckling their mothers with a percentage of 54.3%, followed by calf feeding bottle with a percentage of 45.5% and the bucket method with a very low percentage of 0.2%. Similarly, Koçyiğit et al. (2015) reported that calves took colostrum by sucking their mothers in the majority (82.0%) of cattle enterprises in Hınıs county of Erzurum province, while a calf feeding bottle was used in 10%, a bucket in 7.0% and a bucket with nipple in 1.0% of these farms. In another study carried out by Diler et al. (2017) in the Narman county of Erzurum province, it was found that calves were not given colostrum in 47.0% of the farms, and in the farms where colostrum was given, calves received colostrum by sucking their mothers (40.0%) or by calf feeding bottle (57.0%). Furthermore, 84.0% of the breeders stated feeding colostrum for less than 3 days and the duration of milk feeding for the calves was mostly 4-5 months (51.0%). in Finland, Hanninen et al. (2007) reported that 51.3% of the farms offered colostrum by calf feeding bottle and 36.5% by bucket, while Heinrichs et al. (1987) stated that 57.8% of the colostrum was given by suckling from mother, and the rest was given by buckets with pacifier in USA. However, Vasseur et al. (2010) reported that 92.0% of the farms included in their research gave milk to calves in buckets and 17.7% gave milk in bottles with pacifier in Canada.

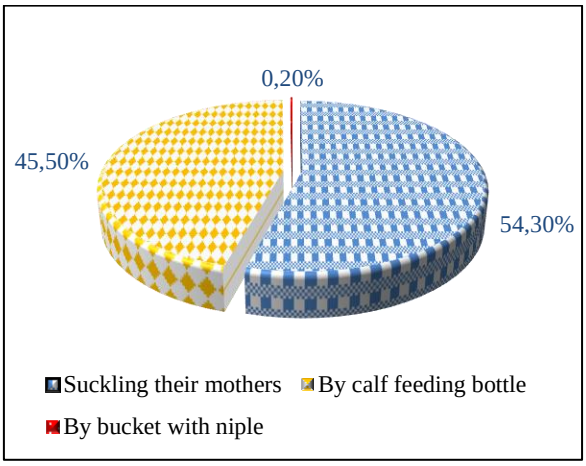

Figure 4. Colostrum feeding methods
Şekil 4. Kolostrumla besleme metotları

When the umbilical cord care of the calves in Horasan county was evaluated, it was found that most of the owners of the enterprise (85.6%) did not perform umbilical cord care of the newborn calves and only 14.4% of them did (Figure 5). This result is in accord with the results of Koçyiğit et al. (2018) and Kaylan et al. (2019) who reported that 73.4% and 85.8% of breeders in Narman county of Erzurum province and Iğdır province did not provide umbilical cord care to newborn calves. On the other hand, Kaygısız et al. (2023) and Koçyiğit et al. (2016) stated that in Torul county of Gümüşhane province (53.0%) and Hınıs county of Erzurum province (45.0%), unlike Horasan county, the percentages of farms that provided umbilical cord care to calves were higher. Ünalan et al. (2013), Kaygısız et al. (2022) and Karaca (2020)

reported similar results in studies conducted in Niğde (72.9%), Andırın county of Kahramanmaraş (96.0%) and Hendek county of Sakarya province (71.3%), respectively.

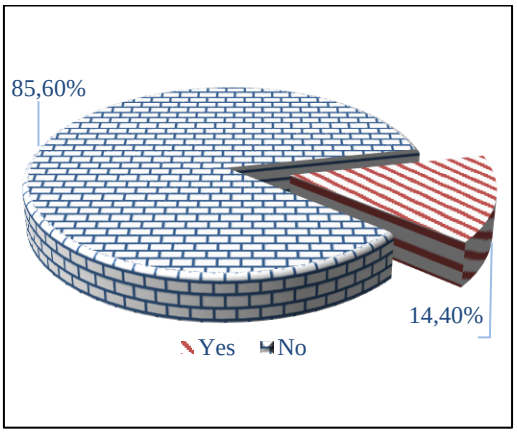

Figure 5. Umbilical cord care for newborn calves
Şekil 5. Yenidoğan buzağılar için göbek kordonu bakımı

Time to initiate feeding hay and concentrate feeds to calves

When calves are born, their rumen is underdeveloped. The rumen must develop before it can digest solid feeds. Dry feed intake are the most significant factors for rumen development in newborn calves. For example, calves fed concentrates in addition to milk will have significantly more papilla development and a much thicker, darker and more vascularised rumen wall. In addition, newborn calves with access to roughage will have positive effects on increasing rumen size and rumen motility, stimulation of rumination and the salivary flow to the forestomach (Gümüş ve Küçükeraslan, 2018). Therefore, it is recommended that dairy calves are started on dry hay at 1-2 weeks of age and calf starter at around 10 days of age (Tüzemen and Yanar, 2013). In Horasan County of Erzurum province, the most of the calves (42.0%) began receiving dry hay for the first time when they reached 2 weeks of age. It was also observed that 32.5% of the cattle enterprises started feeding dry hay when the calves were 3 weeks old. Additionally, 14.7% of cattle farms began feeding dry hay for the first time when the calves were 4 weeks old (Figure 6.). Regarding the timing of the first feeding of concentrates to calves, young animals are generally started on calf starter at the age of 2 weeks (28.3%) or 3 weeks (28.1%) in Horasan County. On the other hand, 14.4%, 7.6%, 6.8% and 7.6% of breeders start feeding concentrates to calves for the first time at 4, 5, 6 and 7 weeks of age respectively (Figure 7.).

In studies conducted in other regions of Turkey, 98.5% of cattle farms in Sivas province started giving calf starter to calves from 6-7 days of age, as reported by Hozman and Akçay (2016), while calves reared in Burdur province received it on average from the ninth day (Oğuz et al., 2013). Çapadağ (2016) found that calves in Yakutiye County of Erzurum Province were given roughage and concentrate feed for the first time at an average age of 24.5±14.6 days. Diler et al. (2016) also stated that the majority (52.0%) of the cattle producers surveyed started giving dry hay and calf starter when their calves were 4 weeks old and 30.0% of them started giving dry hay and calf starter after 4 weeks of age. Furthermore, Kum (2006) indicated that the most of the farms (39.4%) in the central Antalya region started feeding calf starters to calves from the fourth week. It was also reported that 27.5% of the farms in this region started

to give calf starter from the 2nd week. On the other hand, the number of enterprises in Burdur province that started feeding dry feed to calves in the first, second, third, fourth and fifth weeks was 283 (41.8%), 146 (21.6%), 109 (16.1%), 82 (12.1%) and 57 (8.4%), respectively (Elmaz et al. 2010). In a study carried out in Canada (Vasseur, et al. 2010), it was reported that calves had access to the calf starter from the seventh day of life and dry hay from the third day of life. In addition, Heinrichs et al. (1987) reported that 97.9% of cattle producers in Pennsylvania, USA, started feeding with calf starters to new-born calves within the first week of life and 78.7% of breeders began feeding dry hay to calves at 2 weeks of age. In another study carried out in the USA, the average age of access to starter feed for calves was 8.5 days, but access to dry hay was 24.5 days of age (USDA, 2008).

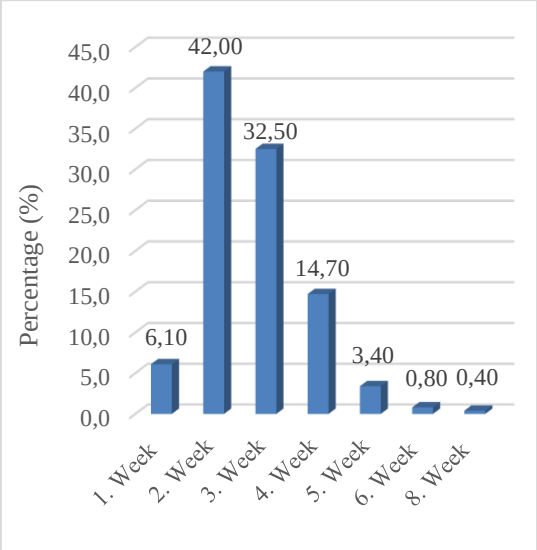

Figure 6. Time to start feeding calves with hay
Şekil 6. Buzağıları kuru otla beslemeye başlama zamanı

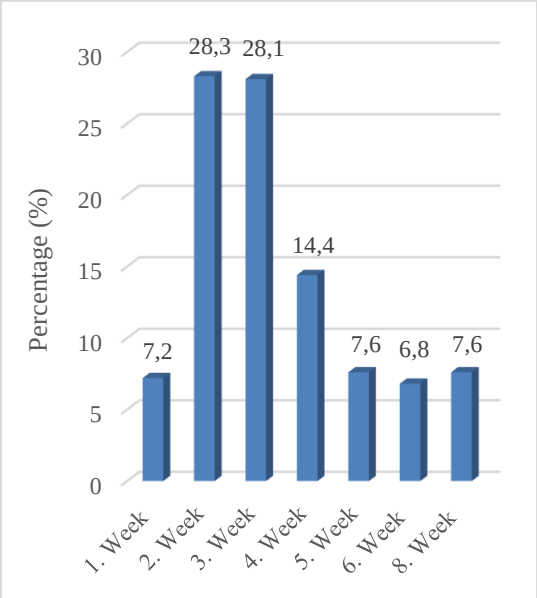

Figure 7. Time to start feeding concentrates to calves
Şekil 7. Buzağılara konsantre yemi vermeye başlama zamanı

Age of calves at water access

Providing calves with free access to water from their first days of life is a straightforward and cost-effective method of enhancing rumen development, average daily weight gain, and preparing them for a seamless transition to weaning (Jones and Heinrichs, 2007). When examining the age at which calves were given free access to water for the first time after birth, it was found that approximately half of the cattle farms (52.3%) surveyed in Horasan county began providing water to calves between 1 and 10 days of age, while approximately one third of the farms offered water to calves between 11 and 20 days of age. Furthermore, 12.3% and 0.6% of farms started watering calves between 21 and 30 days of age and 31 days and later, respectively (Figure 8). A similar result was also reported by Çapadağ (2016), who found that 44.2% of cattle farms in Yakutiye county of Erzurum province gave water to calves for the first time between the first and tenth day after birth, and 21.3% between the eleventh and twentieth day. Furthermore, Özsağlıcak and Yanar (2021) also found that 58.6% of the enterprises surveyed in the central county of Erzincan province had access to water in the first 21 days after birth. On the other hand, Tatar (2007) found that 61.7% of cattle farms located in Ankara and 73.2% in Aksaray started watering calves in the first week of life.

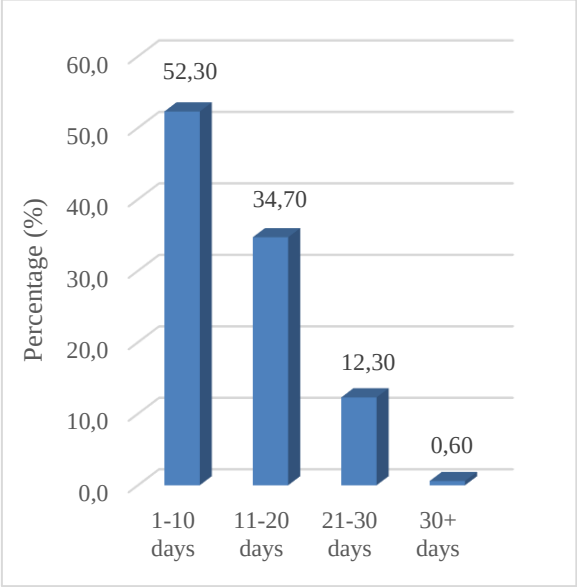

Figure 8. Time to start watering calves

Şekil 8. Buzağıları sulamaya başlama zamanı

In a study carried out by Çapadağ (2016) in cattle farms in Yakutiye county of Erzurum province, it was reported that calves were given water for the first time at an average age of 19.5 days. The same study also reported that 44.2% of the farms allow the water access to the calves for the first time in the period between 1-10 days after birth. Furthermore, the percentages of the cattle farms that started watering their calves in the period between 11 and 20 days and 21-30 days were noted as 21.3% and 27.2% respectively. Furthermore, Diler et al. (2018) reported that 48.1% of the owners of enterprise in Narman county in the same province started watering their calves between 1 and 3 days after birth, 44.7% between 4 and 7 days of age, and 7.2% after one week of age. Similarly, Vasseur et al. (2010) reported that 9.6% of cattle farms in the province of Quebec, Canada, did not allow unweaned calves access to water, although 91.4% of farms allowed calves access to water from an average age of 2.5 days. However, in

the United States, it was indicated that calves are allowed to drink water from an average age of 15.3 days (USDA, 2008). Additionally, Diler et al. (2016) also found that cattle breeders in Hınıs county of Erzurum province generally began watering their calves at 1-2 weeks of age (77.0%). On the other hand, Aydın et al. (2022) reported that 98.7% of cattle farmers in İspir county of the same province did not give water to calves before the age of 3 weeks. The results obtained in Horasan county are quite parallel to the results of the studies mentioned above. It could be said that due to the lack of individual calf pens in cattle farms in Horasan county in general and the housing of calves of different age groups together, the time to start watering calves may be more intensive in the first weeks of life.

Conclusion

In Horasan county, Erzurum province, some incorrect practices were observed during calf breeding in this study. A significant issue is that in a majority of farms (69.5%), daily milk consumption of the calves remains unknown as they receive uncontrolled milk by sucking their mothers. Therefore, it was noted that calves raised in the cattle farms of the county were being given milk in quantities greater or less than required. However, as the milk feeding period is a very critical period for the growth and development of calves as well as for their health, it is imperative that calves are fed milk in the quantities they need during this period. For this reason, it has been recommended that calves in the Horasan county should be given 10% of their birth weight or 4 litres of milk daily by a calf feeding bottle at 2 meals, morning and evening.

Another problem with calf rearing in the county is that calves are usually weaned at a very advanced age. It was found that the highest proportion (38.4%) of farms continue to feed milk during the period when the cows are milked. It has been noted that this situation is due to the difficulties in marketing milk as a result of the widespread use of grazing in the county. For this reason, it was proposed that the Ministry of Agriculture has to provide financial and training support to establish a cold chain for milk transport and deliver milk to dairies by refrigerated vehicles, and to develop awareness among farmers to act collectively in marketing milk.

It was found that 51.8% of the calf breeders in Horasan County started feeding dry hay to calves for the first time in the third or later weeks of life. On the other hand, 64.5% of the farms started feeding concentrates to calves in the same period. Therefore, instead of these erroneous applications, it was recommended to the farmers to start with dry hay for dairy calves at the age of 1-2 weeks and for calf starters at about 10 days. Another important issue in calf rearing was the high rate of neglect of umbilical cord care in newborn calves, which is one of the factors that can lead to calf losses in the neonatal period in Horasan county. The importance of umbilical cord care, which is a simple but effective means of protection against infectious diseases, needs to be recognised by farmers and livestock rearing training for farmers in the county should be intensified to effectively disseminate this care practice.

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Investigation of Heavy Metal Levels in Blood of Anatolian Water Buffalo (*Bubalus bubalis*) Raised in Bitlis Province

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ABSTRACT

In this study, which aims to determine the levels of heavy metals, in the blood of 20 Anatolian buffaloes (Bubalus bubalis) aged 12-18 months, raised in Bitlis province, Güroymak District and fed with ready-made feed ad-libitum in pasture + pen conditions. 3 macro minerals and 14 micro minerals were found in the blood. The levels of a total of 17 minerals were measured by inductively coupled plasma optical emission spectrometry (ICP-OES). Among the macro minerals levels were Ca 43.896±1.216 ppm, Mg 11.381±0.325 ppm, K 133.175±13.959 ppm and micro minerals levels were Al 0.710±0.090 ppm, As 0.027±0.006 ppm, Ba 0.038±0.006 ppm, Co 0.006±0.002 ppm, Cr 0.055±0.010 ppm, Cu 0.218±0.033 ppm, Fe 0.83 2±0.051 ppm, Mn 0.024±0.003 ppm, Mo 0.009±0.002 ppm, Se 0.084±0.009 ppm, Sr 0.050±0.004 ppm, Ti 0.046±0.011 ppm, V 0.058 ±0.014 ppm and Zn 0.168±0.025 ppm. Relationships between minerals are revealed by Pearson Correlation Coefficient ($p<0.05$). In addition, in this study, the ranking of macro and micro minerals and the relative values of some of these minerals (As/Se, Ca/Mg, Ca/Mn, Ca/Zn, Cu/Fe, Cu/Zn, K/Mg, Mn/Fe, Mn/ Mg, Zn/Fe) were presented.

Bitlis İli'nde Yetiştirilen Anadolu Mandalarında (*Bubalus bubalis*) Kandaki Ağır Metal Düzeylerinin Araştırılması

MAKALE BİLGİSİ

Araştırma Makalesi

Geliş: 09.11.2023
Kabul: 19.12.2023

ÖZ

Ağır metal düzeylerinin belirlenmesinin amaçlandığı bu çalışmada Bitlis ili, Güroymak, İlçesi'nde yetiştirilen ve mera+ağıl koşularında ad-libitum olarak hazır yemle beslenen Anadolu mandalarından (Bubalus bubalis) 12-18 aylık yaştaki 20 malağının kanlarında, 3'ü makro mineral ve 14'ü mikro mineral olmak üzere toplam 17 mineralin düzeyi indüktif eşleşmiş plazma optik emisyon spektrometresi (ICP-OES) ile ölçülmüştür Makro minerallerden Ca 43.896±1.216 ppm, Mg

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Anahtar Kelimeler

Ad-libitum besleme
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Kan mineralleri
Ağır metaller
ICP-OES

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11.381±0.325 ppm ve K 133.175±13.959 ppm iken; mikro minerallerden Al 0.710±0.090 ppm, As 0.027±0.006 ppm, Ba 0.038±0.006 ppm, Co 0.006±0.002 ppm, Cr 0.055±0.010 ppm, Cu 0.218±0.033 ppm, Fe 0.832±0.051 ppm, Mn 0.024±0.003 ppm, Mo 0.009±0.002 ppm, Se 0.084±0.009 ppm, Sr 0.050±0.004 ppm, Ti 0.046±0.011 ppm, V 0.058±0.014 ppm ve Zn 0.168±0.025 ppm düzeyinde olduğu belirlenmiştir. Mineraller arasındaki ilişkiler Pearson Korelasyon Katsayısı ($p<0.05$) ile ortaya konulmuştur. Ayrıca bu çalışmada makro ve mikro minerallerin sıralaması ve bu minerallerden bazılarının oransal değerleri de (As/Se, Ca/Mg, Ca/Mn, Ca/Zn, Cu/Fe, Cu/Zn, K/Mg, Mn/Fe, Mn/ Mg, Zn/Fe) sunulmuştur.

Introduction

The buffalo is a farm animal that is bred mainly on the Asian continent. On this continent, India (56.4%) is the country with the highest presence of buffalo wealth in the world. While Pakistan (18.8%) and China (11.7%) took their places in the ranking, they actually undertook a large part of buffalo breeding in the Asian continent. When we look at the European continent, although Italy is the most common buffalo breeding country, it has only 0.2% of the global buffalo wealth. On the other hand, the presence of buffalo in Turkey (0.08%) ranked 19th in the world (Sarıözkan, 2011). In 2016, India ranked 1st with the number of 105 million buffaloes, while Turkey ranked 11th in the world with 134 thousand buffaloes (Anonymous, 2016).

Turkey is a model country known for its intensive buffalo breeding. It has a significant potential with the buffalo population scattered throughout its territory in 7 geographical regions. According to TUIK (2021) data, Samsun (22015 heads), Diyarbakır (2026 heads), Istanbul (15864 heads) and Bitlis (11250 heads) were the leading provinces in terms of buffalo breeding. According to 2020 data, Güroymak district of Bitlis province, which ranks 4th, had the highest buffalo presence (92.8%) in the province with 9809 head of livestock (TUIK, 2020). The advantage of Bitlis in terms of buffalo farming is that it has rich water resources. Even in the macro temperature of Eastern Anatolia, which reaches -30 degrees in winter, the hot spring waters of Güroymak, which reach 40 degrees, were expressed as a perfect fit for buffaloes (Anonymous, 2018). Nemrut Crater Lake and Warm Lake, which are located in the caldera of Nemrut volcano and whose waters are sweet and cold, are among the habitats where buffaloes love to spend time (Anonymous, 2023a). Güroymak plain, where buffalo breeding is intensive, is the continuation of Rahva plain and muş plain. The largest plateau of Bitlis is the Duap plateau, which is also located within the borders of Güroymak district (Anonymous, 2023a). It is also very important to know the healthy blood reference values of these animals, which are so widely breeded.

Like most animal species (McCaughan, 1992, Mc Dowell, 1992), buffaloes require a variety of macro and micro minerals (elements) for health and yield. Some of these minerals are: Calcium (Ca), Potassium (K), Magnesium (Mg), Aluminum (Al), Arsenic (As), Barium (Ba), Cobalt (Co), Chromium (Cr), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Selenium (Se), Strontium (Sr), Titanium (Ti), Vanadium (V) and Zinc (Zn). Although minerals are present in low concentrations in the organism, they participate in the structure of many tissues and act as cofactors of various enzymes (Spears, 1996, Johnson and Socha, 1998).

In the absence or excess of minerals, significant dysfunctions are formed in the organism. Particular emphasis is placed on 15 minerals that are essential for buffaloes in the organism (Fiest, 1999). These minerals are Calcium (Ca), Chlorine (Cl), Cobalt (Co), Copper (Cu), Iron (Fe), Iodine (I), Potassium (K), Magnesium (Mg), Manganese (Mn), Molybdenum (Mo), Sodium (Na), Phosphorus (P), Sulfur (S), Selenium (Se) and Zinc (Zn) (Bülbül, 2010). Deficiency or excess of these minerals may adversely affect reproduction, fertility and immune systems (Mc Dowell, 1992), physiological and/or metabolic problems may occur. Since the early 1980s, some trace elements, which are considered as a subgroup within the microelement's family, have started to be called "ultra-trace elements" (Çelik and Okuyucu, 2005). At the same time, these minerals, which are from the group of minerals and are harmful to the organism, are called "heavy metals". The most common heavy metals, the amount of which is measured through blood tests; Arsenic (As), Cadmium (Cd), Mercury (Hg) and Lead (Pb). Less commonly tested heavy metals are Aluminum (Al), Copper (Cu), Thallium (Ta) and Zinc (Zn) (Anonymous, 2023b). Evaluation of the biochemical parameters of animals is important for clinical approaches (Groff and Zinkl, 1999) and it is also important to know the reference values of the region where the animals are raised. This study aimed to reveal the reference values of some minerals in the blood of healthy buffaloes and the relationship between them.

Materials and Methods

In the decision of Van Yuzuncu Yil University Animal Research Local Ethics Committee, in the Approval Certificate dated 31.01.2023 and numbered 2023/03-01; It was stated that "Animal Research Ethics Committee Approval is not required for the relevant research project."

Ecosystem

The alive material of the study consisted of buffaloes grown in the Güroymak district of Bitlis. Güroymak is at 38° 34' 35.1660" North and 42° 1' 14.2248" East gps coordinates.

Animal material

The alive material of the study consisted of 20 male buffalo calves, which were the offspring of Anatolian buffaloes (*Bubalus bubalis*) in the Mediterranean buffalo group aged 12-18 months, which were raised by the public. Internal-external parasite control was carried out on the animals and routine vaccinations were applied. The animals were fed ad-libitum with ready-made feed consisting of 70% concentrate feed and 30% roughage containing an average of 13-15% protein and 2600 Kcal ME in a semi-intensive system (pasture + pen runs) fattening enterprise.

Blood collection

Before the procedure, the animals were fasted for one night (12 hours). The next morning, after the necessary containment measures were applied to the buffaloes, blood samples were taken from V. jugularis (Kelly, 1984) with non-ionized sterile 10 cc syringes and transferred to gel tubes. The samples brought to the laboratory by cold chain were centrifuged

at room temperature (68 to 72°F / 20 to 22°C) at 3000 rpm for 10 minutes to separate the serum portions. Serums were transferred to 1.5 cc polyethylene tubes using a clean pipette tip for each sample. These tubes were stored in a -20°C freezer until blood analysis was performed (Delves and Camphell, 1988).

Laboratory analysis

The tubes containing the frozen serums were left alone at room temperature to thaw completely. Before the serums were sent to the laboratory, they were transferred to dry tubes and diluted in certain proportions. For this purpose, Triton X-100 (Merck Triton X-100 1.08643) solution was diluted to 1% with deionized water, and serum samples were diluted 10 times with this solution and made ready for heavy metal reading (Dündar et al., 2018). Triton X-100 reagent is frequently used in micromineral analysis of biological fluids in living organisms. This reagent increases the fluidity of fluids such as blood and reduces the heterogeneity that can result from the dilution process.

Today, ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry), which is used especially in micro mineral analysis, is among the most popular techniques. In this study, the analyses of macro minerals (Ca, K, Mg) and micro minerals (Al, As, Ba, Co, Cr, Cu, Fe, Mn, Mo, Se, Sr, Ti, V, Zn) were carried out at Van Yuzuncu Yil University, Science Application and Research Center. For this, Thermo Scientific brand, CAP6300DOU model device was used. The determination limit of the minerals is 1 µg/L and the confidence interval of the analysis results is 99%. The results of the analysis were evaluated as the average of 2 measurements.

Statistical Analysis

SAS 9.4 (2014) package program was used for the statistical evaluation of the data obtained as a result of the research, Proc means were used for introductory statistics and Porc t test procedures were used for the comparison of groups. The relationships between minerals were revealed by Pearson Correlation Coefficient ($p<0.05$). In addition, the ranking of macro and micro minerals (Patkowska-Sokola et al., 2009) and the proportional values of some of these minerals (As/Se, Ca/Mn, Ca/Mg, Ca/Zn, Cu/Fe, Cu/Zn, Mn/Fe, Mn/Mg, K/Mg, Zn/Fe) are also presented in this study (Jacobson et al., 1971; Mortimer et al.1999). In the interpretation of the literature in the discussion section, the following unit translations were applied.

1 ppm= 1 mg/L = 1000 µg/L= 0.1 mg/dL= 1 mg/kg
1 mmol/L= 1000 µmol/L
1 µg/100 ml = 0.001 ppm = 1 ng/g

Fe:	1 mg/L = 0.0250 mmol/L	(Anonymous, 2023c)
	1 µmol/L = 5.5865 µg/dL	(Anonymous, 2023d)
K:	1 mg/L = 0.0256 mmol/L	(Demir et al., 2020)
Cu:	1 mg/dl = 160 µmol/L = 0.16 mmol/L	(Anonymous, 2023d, 2023e)
Zn:	1 µmol/L = 6.538 µg/dl	(Anonymous, 2023f)
Mn:	1 *mEq/L* = 0.0364 *mg/L*	*(*Anonymous, 2023g)

Results

Each mineral and the selected wavelengths (ƛ) for that mineral were presented in Table 1. The concentration values used to plot the six-point calibration curve at these wavelengths were 0.000, 0.500, 1.000, 3.000, 5.000, 7.000 µg/L. An example Ca graph was presented in Figure 1.

Table 1. Mineral wavelengths (ƛ)
Tablo 1.Mineral dalga boyu (ƛ)

Mineral	Mineral subgroup	Mineral name	Mineral symbol	Mineral wavelength (λ): nm
Macro		Calcium	Ca	393.366
		Potassium	K	766.490
		Magnesium	Mg	279.553
Micro	Micro	Cobalt	Co	228.616
		Chromium	Cr	283.563
		Copper	Cu	324.754
		Iron	Fe	259.940
		Manganese	Mn	257.610
		Molybdenum	Mo	202.030
		Selenium	Se	196.090
		Zinc	Zn	213.856
	Ultra-trace	Aluminium	Al	167.079
		Arsenic	As	167.079
		Barium	Ba	455.403
		Strontium	Sr	407.771
		Titanium	Ti	334.941
		Vanadium	V	309.311

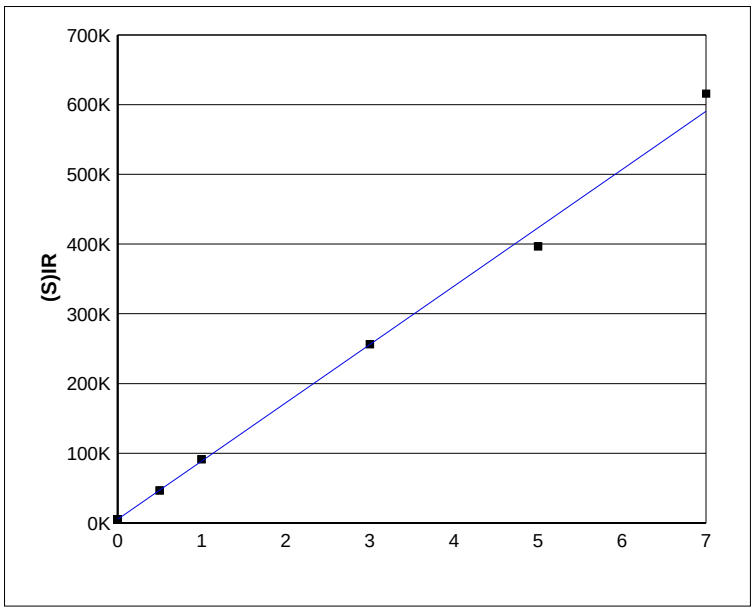

Figure 1. Calibration graph of the element Ca measured at a wavelength of 393.366 nm
Figure 1. 393.366 nm dalga boyunda ölçülen Ca elementinin kalibrasyon grafiği

Mean concentration±standard error (Mean±SE) and minimum-maximum values of serum macro and micro mineral values of Anatolian malaks were presented in Table 2.

Table 2. Serum mineral values of Anatolian buffalo calves (ppm)
Tablo 2. Anadolu malaklarının serum mineral değerleri (ppm)

Mineral	Mineral subgroup	Mineral symbol	Mean ± SE	Minimum-Maximum	Median
Macro		Ca	43.896±1.216	30.970-51.824	44.353
		K	133.175±13.959	61.834-315.904	111.335
		Mg	11.381±0.325	8.448-14.105	11.677
Micro	Micro	Co	0.006±0.002	0.001-0.030	0.005
		Cr	0.055±0.010	0.004-0.094	0.055
		Cu	0.218±0.033	0.016-0.624	0.188
		Fe	0.832±0.051	0.448-1.427	0.811
		Mn	0.024±0.003	0.005-0.041	0.023
		Mo	0.009±0.002	0.001-0.029	0.009
		Se	0.084±0.009	0.017-0.158	0.084
		Zn	0.168±0.025	0.026-0.403	0.138
	Ultra-trace	Al	0.710±0.090	0.118-1.416	0.621
		As	0.027±0.006	0.006-0.105	0.017
		Ba	0.038±0.006	0.002-0.081	0.036
		Sr	0.050±0.004	0.028-0.091	0.048
		Ti	0.046±0.011	0.001-0.118	0.032
		V	0.058±0.014	0.000-0.194	0.044

The ranking of minerals according to the literature (Patkowska-Sokola et al., 2009) was presented in Table 3.

Table 3. Ranking of the mean (x) of serum mineral values of Anatolian buffalo calves
Tablo 3. Anadolu manda buzağılarının serum mineral değerlerinin ortalama (x) sıralaması

Makro minerals			Mikro minerals													
K>	Ca>	Mg>	Fe>	Al>	Cu>	Zn>	Se>	V>	Cr>	Sr>	Ti>	Ba>	As>	Mn>	Mo>	Co

The values of serum macro and micro minerals of Anatolian buffalo calves regarding Pearson correlation coefficients were presented in Table 4, Table 5 and Table 6, respectively.

Table 4. Pearson Correlation Coefficients of serum mineral values of Anatolian buffalo calves-I
Tablo 4. Anadolu malaklarının serum mineral değerlerinin Pearson Korelasyon Katsayıları-I

	Al	As	Ba	Ca	Co	Cr	Cu	Fe	K
Al	1.000	-0.131	0.242	-0.401	-0.352	-0.622	-0.324	-0.230	-0.184
As		1.000	0.159	-0.114	0.010	0.365	0.722*	0.247	0.720**
Ba			1.000	0.215	-0.276	0.101	0.227	-0.540	0.044
Ca				1.000	0.524*	0.060	0.173	0.240	0.097
Co					1.000	0.147	0.120	0.698*	-0.122
Cr						1.000	0.039	-0.025	0.641
Cu							1.000	0.345	0.421
Fe								1.000	0.228
K									1.000

* p < 0.05, ** p < 0.01, statistically significant coefficient of correlation

Table 5. Pearson Correlation Coefficients of serum mineral values of Anatolian buffalo calves-II
Tablo 5. Anadolu malaklarının serum mineral değerlerinin Pearson Korelasyon Katsayıları-II

	Mg	Mn	Mo	Se	Sr	Ti	V	Zn
Mg	1.000	-0.019	0.302	0.235	-0.070	-0.053	0.043	-0.381
Mn		1.000	-0.495	-0.477	-0.174	-0.686*	-0.287	-0.356
Mo			1.000	0.607*	0.270	-0.294	0.194	0.472
Se				1.000	0.033	0.168	0.083	0.499*
Sr					1.000	0.090	-0.302	0.031
Ti						1.000	0.305	-0.027
V							1.000	0.118
Zn								1.000

* p < 0.05, statistically significant coefficient of correlation

Table 6.Pearson Correlation Coefficients of serum mineral values of Anatolian buffalo calves-III
Tablo 6. Anadolu malaklarının serum mineral değerlerinin Pearson Korelasyon Katsayıları-III

	Mg	Mn	Mo	Se	Sr	Ti	V	Zn
Al	-0.233	0.161	0.007	-0.031	-0.017	-0.074	-0.321	0.232
As	-0.203	-0.066	0.007	0.269	0.055	-0.311	-0.013	0.327
Ba	0.081	0.617*	-0.671*	-0.404	-0.409	0.007	-0.626*	-0.636*
Ca	0.800	0.044	0.082	-0.025	-0.290	0.057	0.103	-0.497*
Co	0.637**	-0.304	0.807**	0.438	0.040	-0.323	0.228	0.203
Cr	-0.036	0.122	0.147	0.020	0.484	0.436	-0.046	-0.406
Cu	-0.114	0.373	-0.216	0.019	-0.387	-0.504	0.269	0.071
Fe	0.183	-0.206	0.622*	0.097	0.124	-0.457	0.269	0.347
K	-0.015	-0.083	-0.010	0.083	0.035	0.002	-0.026	0.189

* p < 0.05, ** p < 0.01, statistically significant coefficient of correlation

Table 7. Proportional relationships of serum mineral values of Anatolian buffalo calves
Tablo 7. Anadolu malaklarının serum mineral değerleri arasındaki orantısal ilişkiler

Mineral Ratios	Proportional Values	Interaction Direction*	Interaction Mode**	Literature
Al/ Co	118.333	Belirtilmemiş	-	Mortimer et al. 1999
Al/ Mg	0.062	Belirtilmemiş	-	Mortimer et al. 1999
As/ Se	0.321	→	-	Jacobson et al., 1971; Mortimer et al. 1999
Ca/ Mg	3.857	→	Antagonism	Jacobson et al., 1971
Ca/ Mn	1.829	→←	Antagonism	Jacobson et al., 1971; Mortimer et al. 1999
Ca/ Zn	261.286	→	Antagonism	Jacobson et al., 1971; Mortimer et al. 1999
Co/ Fe	0.667	Belirtilmemiş	-	Mortimer et al. 1999
Cu/ Fe	0.262	→	Antagonism	Jacobson et al., 1971; Mortimer et al. 1999
Cu/ Mo	24.222	Belirtilmemiş	Stimulation	Mortimer et al. 1999
Cu/ Zn	1.298	→	-	Jacobson et al., 1971; Mortimer et al. 1999
K/ Mg	11.702	→	Antagonism	Jacobson et al., 1971
Mn/ Fe	0.029	→	Antagonism	Jacobson et al., 1971; Mortimer et al. 1999
Mn/ Mg	0.002	→	-	Jacobson et al., 1971; Mortimer et al. 1999
Zn/ Fe	0.202	→	Antagonism	Jacobson et al., 1971; Mortimer et al. 1999

* "Direction of interaction of minerals" reported by Jacobson et al. (1971)
** "Mode of interaction of minerals" reported by Georgievskii (1982)

There are also close relationships between minerals in terms of the use of minerals by animals (Okuyan, 1997). Based on this, according to the literature (Jacobson et al., 1971; Mortimer et al. 1999) the proportional relationships of minerals to each other were presented in Table 7. The direction of interaction (Jacobson et al., 1971) is indicated by arrows, and the mode of interaction (Georgievskii, 1982) was added to the same table.

Discussion and Conclusion

Macro minerals

Ca: According to the results of a study conducted by Hagawane et al. (2009), the mean Ca values of lactated healthy buffaloes was found to be as 11.21±0.19 mg/dl. In a study conducted by Chhabra et al. (2015) on buffaloes, the Ca values of blood plasma in summer and winter months were measured as 8.92±0.26 mg/dl and 9.74±0.30 mg/dl, respectively. In a study investigating the effect of season on blood minerals in Iraqi buffaloes (Kadhim and Al-Dulaimi, 2015), the Ca values were recorded in autumn, winter, spring and summer were reported as 2.39, 2.41, 2.22, 2.51 mmol/L, respectively. According to the results of a study conducted by Runa et al. (2022) on Murrah buffaloes, the average blood Ca values of male and female young calves was 8.78±0.57 mg/dl; The Ca level of male animals was determined as 8.30±0.30 mg/dl. In this study, it was determined that the mean blood Ca value of the buffalo calves used lower than the values reported in the aforementioned literatures.

K: Khadjeh et al. (2005) found the serum K level of Iranian Khuzestan male buffaloes to be as 5.35±0.98 mmol/L. Souza et al. (2019) determined the blood K level as 4.89±0.46 mmol/L on the 30th day after birth in buffaloes with multiple births. According to the results of a study conducted by Runa et al. (2022) on Murrah buffaloes, the mean blood K values of male and female young buffalo calves was 5.23±0.08 mmol/L; the K level of male animals was determined as 5.25±0.12 mmol/L. In this study, it was determined that the mean

blood K value of the buffalo calves used lower than the values reported in the aforementioned literatures.

Mg: Hagawane et al. (2009) determined the blood Mg level of lactating buffaloes raised in the city of Parbhani as 3.50±0.17 mg/dl. According to Shoushtari et al. (2014), blood Mg levels of female water buffaloes was 4.27±0.21 mg/dl before puberty and 5.71±0.48 mg/dl at estrus. Dhamsaniya et al. (2016) reported the serum Mg level of the control group as 3.57±0.12 mg/dl in Surti buffaloes. In this study, it was determined that the mean blood Mg value of the buffalo calves used lower than the values reported in all the literatures.

Micro minerals

Al: As a result of the study conducted by Gaafar (2008) in Egypt, it was stated that the plasma Al average of buffaloes was 25.30 µg/100 ml, while the plasma Al average of cattle was 20.61 µg/100 ml. It was determined that the mean blood Al value of the buffalo calves used in this study considerably higher than the values reported by Gaafar (2008) about both buffaloes and cattles.

As: According to Khan et al. (2020), average As levels in Niliravi buffaloes were between 0.023-0.069 mg/L in winter; it ranged between 0.020-0.064 mg/L in summer. Puis (1981) reported that the toxic limit for As in buffaloes was 1 ppm. Mean blood As value of buffalo calves used in this study were determined by Khan et al. (2020) was slightly higher than the value reported. However, it was found to be well below the toxic limit reported by Puis (1981).

Ba: According to Luna et al. (2019), the plasma value of the cattle whose Ba levels were investigated in the blood as 13.6±1.05 µg/L, while the serum value was 13.5±1.20 µg/L. Hussein et al. (2022) determined the lactating serum Ba level as 16 µg/L. In this study, it was determined that the mean blood Ba value of the buffalo calves used higher than the values of the cattle reported in the aforementioned literatures.

Co: Khan et al. (2018) reported the mean plasma Co of buffaloes with potentially toxic metal accumulations in the blood as 0.19-0.21 mg/L. Dhamsaniya et al. (2016) measured the serum Co level of the control group as 1.52±0.04 mg/dl in Surti buffaloes. Mc Dowell (2003) reported the critical level for Co as 0.25 mg/L. In this study, it was determined that the mean blood Co value of the buffalo calves used considerably lower than the values reported in the aforementioned literatures.

Cu: The blood Cu content of lactating buffaloes was determined as 1.21 mg/kg by Sharma and Prasad (1982). Yadav et al. (1998) reported that the average Cu content of the blood serum of buffaloes in the Rewari region as 0.47 mg/kg. According to the results of the study conducted by Mandal et al. (1996) on dairy buffaloes in Mohindergarh, the average Cu content of the blood serum was 0.67 mg/kg. Gaafar (2008) stated that the average plasma Cu as 112.30 µg/100 ml in the study conducted on buffaloes in Egypt. In a study conducted by Kadhim and Al-Dulaimi (2015), the Cu values of Iraqi buffaloes recorded in autumn, winter, spring and summer were reported as 68.63±11.35 mmol/L, 67±72.69 mmol/L, 64.15±5.22 mmol/L and 54.56±2.68 mmol/L, respectively. In the study conducted by Chhabra et al. (2015) on buffaloes, the Cu values of blood plasma in summer and winter months were measured as 12.68±0.35 µmol/L and 12.68±1.45 µmol/L, respectively. It was determined that the mean blood Cu value of the buffalo calves used in this study significantly lower than the values reported by Sharma

and Prasad (1982), Mandal et al. (1996) Yadav et al. (1998) and Kadhim and Al-Dulaimi (2015), but higher than the values reported by Gaafar (2008) and Chhabra et al. (2015).

Cr: According to Luna et al. (2019), the plasma value of the cattle whose investigated Cr levels in blood was 5.72±0.49 µg/L, while the serum value as 5.06±0.44 µg/L. Hussein et al. (2022) found the serum Cr level in lactating cows to be as 83 µg/L. In this study, it was determined that the mean blood Cr value of the buffalo calves used considerably higher than the values of the cattle reported in the aforementioned literatures.

Fe: In a study conducted by Georgievskii et al. (1982), it was reported that the average serum Fe level of buffaloes fed with feed and roughage with very high Fe content varied between 1.1-2.5 ppm. Sharma et al., (1991) found that the serum Fe levels of animals fed Fe content under different mineral levels as 1.47, 1.64 and 1.69 mg/kg. In the study conducted by Chhabra et al. (2015) on buffaloes, the Fe values of blood plasma in summer and winter months were measured as 47.53±2.07 µmol/L and 51.93±5.92 µmol/L, respectively. In this study, it was determined that the mean blood Fe value of the buffalo calves used lower than the values reported in the literatures.

Mn: Sharma et al. (1991) observed that the serum Mn content of animals treated at different mineral levels as 0.59 and 0.65 mg/kg. In the study conducted by Chhabra et al. (2015) on buffaloes, the Mn values of blood plasma in summer and winter months were measured as 0.82±0.04 µmol/L and 0.80±0.09 µmol/L, respectively. According to the results of a study conducted by Runa et al. (2022) on Murrah buffaloes, the mean blood Mg values of male and female young buffalo calves was 2.04±0.04 mEq/L while the Mg level of male animals was determined as 2.03±0.06 mEq/L. The mean blood Mn value of the buffalo calves used in this study was significantly lower than the values reported by Sharma et al. (1991) while higher than the values reported by Chhabra et al. (2015) and Runa et al. (2022).

Mo: According to Khan et al. (2020), the average Mo levels in buffaloes were between 2.61 mg/L and 2.70 mg/L in winter while it ranged between 1.82 mg/L and 2.26 mg/L in summer. Clawson et al. (1972) reported the toxic level of Mo in buffaloes as 5 ppm. In this study, it was determined that the mean blood Mo value of the buffalo calves used considerably lower than the values reported in the aforementioned literatures.

Se: Khan et al. (2018) measured the Se level of buffalo plasma as 0.02 mg/kg in their study in Jhang. According to Khan et al. (2020), the average Se levels in all buffaloes were between 0.017 and 0.028 mg/L in winter while it ranged from 0.012 to 0.024 mg/L in summer. Mc Dowell (1997) reported that the critical limit for serum Se concentration as 0.03 mg/L. In this study, it was determined that the mean blood Se value of the buffalo calves used higher than the values reported in the literatures.

Sr: According to Luna et al. (2019), the plasma value of the cattle whose Sr levels was 118±5 µg/L, while the serum value measured as 117±5 µg/L. In this study, it was determined that the mean blood Sr value of the buffalo calves used lower than the values of the cattle reported in the literature.

Ti: According to the results of a study conducted by Sarmiento-González et al. (2009), in which Ti levels in the organs and blood of rats were investigated, the blood Ti level was determined as 2.36±0.48 ng/g. It was determined that the mean blood Ti value of the buffalo calves used in this study was significantly higher than the value of rats reported in the literature.

V: Cornelis et al. (1981) stated that the normal level of V in the blood serum should be in the range of 0.016-0.939 ng/ml, and if it is above 1.0 ng/ml, it is likely that exposure to V is possible. In a study examining the effects of inorganic vanadium supplementation on antioxidant enzymes, immune status and hemato-biochemical properties of growing hybrid calves, blood V level of male Karan Fries calves (Tharparkar × Holstein Friesian) was reported as 0.97 mg/kg by Pal et al. (2018). Mean blood V value of the buffalo calves used in this study were within the physiological limits reported by Cornelis et al. (1981), while it was found to be considerably lower than the calf value reported by Pal et al. (2018).

Zn: Yadav et al. (1998) reported that the mean serum Zn content of buffaloes raised in the Rewari region was 2.76 mg/kg. As reported by Mandal et al. (1996), the average Zn content in blood serum in Milch buffaloes in Mohindergarh district was 2.80 mg/kg (Baloda and Promila, 2018). In the study conducted by Chhabra et al. (2015) on buffaloes, the Zn values of blood plasma in summer and winter months were measured as 10.90±0.45 µmol/l and 22.20±2.53 µmol/L, respectively. According to the results of a study conducted by Runa et al. (2022) on Murrah buffaloes, the mean blood Zn value of male and female young buffalo calves was 115.45±3.88 mg/dl while the Zn level of male animals was determined as 116.74±5.85 mg/dl. The blood Zn values of the buffalo calves used in this study was considerably lower than the values reported by Yadav et al. (1998) and Baloda and Promila (2018) while it was determined that it was considerably higher than the value reported by Runa et al. (2022).

Of the analyzed minerals, correlation between As-Cu, Ba-Mn, Ca-Co, Co-Fe, Mo-Se, Se-Zn were positive at $p<0.05$ level while corelation between Ba-Mo, Ba-V, Ba-Zn, Ca-Zn, Mn-Ti were negative at $p<0.05$ level. Also, a positive correlation was found between As-K, Co-Mg and Co-Mo at $p<0.01$ level. Additionally, the correlations between Ca-Zn, with a proportional value of 261.286, and Co-Fe, with a proportional value of 0.667, supported the antagonistic effect reported by Georgievskii (1982).

The most common way for heavy metals to enter metabolism is drinking water. Heavy metals taken into the body through inhalation can also cause diseases, especially in the lungs, liver and kidneys (Ayaz and Yurttagül, 2012). This situation in living things causes similar symptoms. However, it was clearly seen in the literature review that there are not many studies on heavy metal levels to be used to evaluate the situation in buffaloes. There is very little literature on blood levels of Al, Ti and V, especially in buffaloes. For this reason, there is a need for comprehensive mineral studies, especially Al, Ti and V, in which comparisons will be made with buffaloes and cattle and thus species-specific reference values will be revealed.

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Yazarlar İçin Bilgi

Makale Yazım Kuralları

Hayvan Bilimi ve Ürünleri Dergisi, yılda 2 kez yayınlanmaktadır (ISSN: 2667-4580). Derginin kısa adı JASP'dır. Dergi kapsam olarak, hayvan bilimi ve üretiminin tüm aşamalarını içerir.

Hayvan Bilimi ve Ürünleri Dergisi, açık erişimli uluslararası bir dergidir. Her kullanıcı veya kurum ücretsiz olarak tüm yayınlara ulaşabilir. Yayıncı veya yazardan izin almadan kullanıcılar, makalelerin tam metinlerini okuyabilir, indirebilir, kopyalayabilir, yazdırabilir, bağlantı verebilir ve diğer yasal amaçlarla kullanabilir.

Makale türleri

Dergimizde, orijinal tam metin araştırma makaleleri, kısa araştırma makaleleri, bilimsel raporlar, vaka raporları, teknik notlar, editöre mektuplar, derlemeler ve gerektiğinde araştırma ve konferans kitapları yayınlanır.

Orijinal (tam metin) araştırma makaleleri, bilimsel çalışmalara, gözlemlere ve deneylere dayanan özgün bilimsel makalelerdir. Makale, başlık, özet ve anahtar kelimeler, giriş, materyal ve yöntem, bulgular, tartışma ve kaynaklar kısmından oluşur. Makale 20 sayfayı geçmemelidir. Özet, 300 ± 50 kelime içermelidir.

Kısa araştırma makaleleri, 6 sayfadan az olan araştırma makalelerdir. Makale, özgün olmalı, başlık, özet ve anahtar kelimeler, giriş, materyal ve yöntem, bulgular, tartışma ve kaynaklar kısımlarını içermeli, ancak özet kısmı 150 kelimeyi geçmemelidir.

Bilimsel raporlar, orijinal araştırma bulgularının kısa özetidir. Rapor, tam metin orijinal araştırma makalesi formatında hazırlanmalıdır. Bilimsel raporların uzunluğu, toplamda 6 sayfadan fazla olmamalıdır.

Vaka raporları, hayvan bilimi ve ürünleri hakkında sahada, uygulama ve laboratuvar çalışmalarında karşılaşılan güncel bulguların bildirimleridir. Vaka raporunun başlığı ve özeti tam metin araştırma makalesi formatında yazılmalı, geri kalan bölümleri, giriş, vaka tarihçesi, tartışma ve kaynaklar kısımları takip etmelidir. Vaka raporlarının uzunluğu, en fazla 6 sayfa ile sınırlandırılmıştır.

Teknik notlar, hayvan bilimi ve üretimi ile ilgili yöntemlerin ve teknik bilgilerin yer aldığı makalelerdir. Teknik notun, başlığı ve özeti, tam metin orijinal makaleler gibi yazılmalı ve geriye kalan bölümler giriş, metin (uygun başlıklar ile birlikte), sonuç ve kaynaklar kısımlarını takip etmelidir. Teknik notların uzunluğu toplamda 6 sayfadan fazla olmamalıdır.

Editöre mektuplar, bilimsel veya pratik yararı olan bir konuyu veya vakayı dikkat çeken yazılardır. Mektuplar, 2 sayfadan fazla olmamalıdır.

Derlemeler, belirli bir konu ile ilgili literatür araştırmasına dayanır. Derlemenin başlığı ve özeti, tam metin orijinal makale formatında hazırlanmalı ve kalan bölümleri giriş, metin (uygun başlıklar ile

birlikte), sonuç ve kaynaklar kısımlarının takip etmesi gerekir. Derlemenin uzunluğu, toplamda 16 sayfadan fazla olmamalıdır. Davetli derlemelerin yayınlanması önceliklidir.

Makale hazırlama

MAKALE YÜKLEME DOSYALARI İÇİN ŞABLONLAR

1. Tam Makale olarak; Makalenin yazar isimli versiyonu,
2. Ek dosyalar kısmına ise; Makalenin yazar isimsiz versiyonu,
3. Başlık Sayfası kısmına Makale başlığı ile tüm yazarların bilgilerinin olduğu sayfa,
4. Telif Hakları Devir Sözleşmesi Formu
5. Benzerlik Raporunu (en fazla % 24)

Hayvan Bilimi ve Ürünleri Dergisi'nde (Journal of Animal Science and Products (JASP)) yer alacak makaleler, aşağıdaki kurallara göre yazılmalı ve on line olarak yüklenmelidir.

1. Dergimiz, Türkçe ve İngilizce makaleleri kabul etmektedir. Makale yazım dili Türkçe ise özet kısmının, şekil ve tablo isimlerinin İngilizcelerinin de verilmesi gerekmektedir. Benzer şekilde ingilizce makalelerin de Türkçe özetleri yazılmalıdır. Ayrıca, tablo ve şekil açıklamalarının da Türkçeleri yazılmalıdır.

2. Makalelerin etik kurallara uygunluğu yazarların sorumluluğundadır. Benzerlik analiz raporunun sistemine yazar tarafından yüklenmesi gerekmektedir. Kaynaklar, Makale Başlığı, Tablo ve Şekil isimleri hariç tutulmalıdır. Diğer bilimsel yayınlara benzerlik oranının %24'ü geçmemesi gerekir. Bununla beraber editör, gerektiğinde yazarlardan etik kurul belgesi isteme hakkını saklı tutar.

3. Eserler, Editörler Kuruluna Word programıyla, A4 botundaki kağıda makale metni Times New Roman tipi harflerle (12 punto) ve 1,15 aralıklı yazılmalı ve 20 sayfayı geçmemelidir. Sayfanın sağında, solunda, altında ve üstünde 2,5'er cm boşluk bırakılmalıdır.

4. Makale içerisinde kaynak kullanım şekli APA'ya göre yapılmalıdır.

5. Tüm makalelerde SI (Systeme International d'Units) ölçüm birimleri kullanılmalıdır. Kısaltma ve semboller metin içerisinde ilk kez kullanıldığında açıklanmalıdır. Kısaltmalar makalenin başlığında kullanılmamalıdır.

6. Formüller ve denklemler numaralandırılmalı ve formül numarası formül'ün yanına sağa dayalı olarak parantez içinde gösterilmelidir.

7. Kabul edilen ve yayımlanan makaleler için yazarlara herhangi bir ücret ödenmez.

8. Yayımlanmak üzere kabul edilen makalelerin her türlü yayın hakkı dergiyi yayımlayan kuruma aittir. Makalelerdeki düşünce ve öneriler tümüyle yazarların sorumluluğundadır.

9. Yazarlar, online olarak makale başvurusu yaparlar. Online başvuru sisteminden yapılan başvuru sırasında yazarlar toplam 5 dosya

Bunlar;

1. Tam Makale olarak; Makalenin yazar isimli versiyonu,
2. Ek dosyalar kısmına ise; Makalenin yazar isimsiz versiyonu,
3. Başlık Sayfası kısmına Makale başlığı ile tüm yazarların bilgilerinin olduğu sayfayı,
4. Telif Hakkları Formu ve
5. Benzerlik Raporunu (en fazla % 24) sunmalıdır. Yanlış ve eksik yapılan başvurular değerlendirilmeye alınmaz.

10. Makalede yer alan tüm yazarlar, yayın haklarını Hayvan Bilimi ve Ürünleri Dergisi'ne (Journal of Animal Science and Products (JASP)) verdiklerine dair Telif Hakları Formunu (https://dergipark.org.tr/tr/journal/3237/file/3291/download adresinden indirilebilir) imzalamalıdırlar. Makalede yer alan tüm şekil ve tablolar makale içerisinde ilgili yerlerinde sunulmalıdır.

11. Dergimize makalelerinizi, https://dergipark.org.tr/tr/pub/jasp/page/8770 adresindeki adımları takip ederek yükleyebilirsiniz.

Makalenin Kısımlarına İlişkin Kurallar

Makale başlığı (Article title)

Çalışmanın Türkçe Başlığı Her Kelimenin İlk Harfi Büyük (Bağlaçlar Hariç) ve "Times New Roman" Fontunda 14 Punto Olacak ŞekildeYazılmalıdır.

Yazar İsimleri (Author Names)

"Times New Roman" Fontunda 12 Punto Olacak Şekilde Yazılmalıdır.

Yazar Bilgileri (Author Information)

"Times New Roman" Fontunda 10 Punto Olacak Şekilde Yazılmalıdır.

Özet (Abstract)

"Times New Roman" Fontunda 10 Punto Olacak Şekilde Yazılmalıdır.Bu kısımda çalışmanın amacı, kullanılan materyal(ler) ve yöntem(ler), önemli bulgular ve varılan sonuç(lar) açık ve öz olarak belirtilmelidir. Metin, Türkçe yazım kurallarına uygun olarak "Times New Roman" fontunda 10 punto, tek satır aralıklı ve bir paragrafta yazılmalıdır. Lütfen yazım alanı sınırlarını sağ-sol yönlerde değiştirmeyiniz. Bu kısımda eklenecek metin en fazla (300) kelime olmalı ve kapak sayfası bir sayfayı aşmayacak şekilde düzenlenmelidir. Eğer çalışmanızı İngilizce olarak sunmak istiyorsanız; ilk başlığı, özeti ve anahtar kelimeleri İngilizce olarak bu kısımda; Türkçe başlık, özet ve anahtar kelimeleri ise aşağıdaki kısımda veriniz. Yazar isimleri ve adresleri ile tarih bilgilerini içeren kısımlarda değişiklik yapmayınız. Çalışmanız yayınlandığında cilt, sayı, sayfa numarası ve tarih bilgileri tarafımızca güncellenecektir. Bu kısımlarda değişiklik yapmayınız.

Anahtar Kelimeler (Keywords)

“Times New Roman” Fontunda 10 Punto Olacak Şekilde Yazılmalıdır. Çalışmanızı en iyi şekilde tanımlayacak 4-6 anahtar kelime alt alta olacak şekilde eklenmelidir.

Giriş (Introduction)

Okuyucuyu konuya hazırlayıcı nitelikli bilgileri içermelidir. Metin içinde paragraftan önce ve sonra boşluk eklenmemiş olduğunu “Satır ve Paragraf Aralığı” düzenleyicisi ile “Satır Aralığı Seçenekleri” bölümünden “Aralık” kısmında “Önce” ve “Sonra” değerlerinin sıfır (0) olduğunu görerek kontrol ediniz. “Giriş” başlığı ile metin arasında bir boşluk ekleyiniz ve bu başlık altındaki metin içerisindeki her paragraf başında bir tab (1.25 cm) boşluk bırakarak metni ekleyiniz.

Materyal ve Yöntem (“Materials and Methods”)

Bu kısımda, İn vivo çalışmalar için çalışmanın etik kurul onay belgesinin sayı ve tarihi verilmelidir.

Materyalde üzerinde çalışılan malzemeler, objeler, çalışma alanı, zaman ve sınırlılıklardan bahsedilmelidir. Materyal ile ilgili tablo, şekil vb. bilgiler bu bölümde yer almalıdır.

Yöntem ise araştırmanın amacına ulaşmasında kullanılan teknik ya da tekniklerdir. Kullanılan yöntem(ler) yeni ise açık ve anlaşılır bir şekilde ayrıntılı olarak verilmelidir. Eğer kullanılan yöntem bilinen bir yöntem ise, sadece kaynak gösterilerek adının verilmesi yeterlidir.

Materyal ve yöntem alt başlığı (isteğe bağlı) (Subtitle (optional)

Bu bölümünde alt başlık altında bilgi verilmesi durumunda alt başlık, “Times New Roman” fontunda, 12 punto, kalın ve italik olarak yazılmalıdır. Alt başlığın ilk kelimesinin ilk harfi büyük, geri kalan kısmı küçük harflerle yazılmalıdır. Alt başlıklardan sonra boşluk bırakılmamalıdır.

Çalışma metni içerisinde denklem yer alacak ise bunlar kenarlıklar gizlenmiş tek satırlık bir tablo içerisinde iki hücre ile verilmelidir. Sol hücreye denklem eklenmeli ve bu hücre ortalı olmalıdır. Sağ hücrede ise denklem numarası yer almalı ve bu hücre sadece denklem numarasının sığacağı büyüklükte, sağa dayalı olmalıdır. Denklem ifadelerinden önceki ve sonraki paragraflar arasında birer satır boşluk olmalıdır.

Bulgular (Results)

Bu kısımda elde edilen bulguları içermeli, şekil ve tablolarda da desteklenmelidir. Bulgular kısmında kaynak gösterilmemelidir.

Tablo dışında kalan fotoğraf, resim çizim ve grafiklerin hepsi “Şekil” olarak verilmelidir. Resim, şekil ve grafikler net ve ofset baskı tekniğine uygun olmalıdır. Her tablo ve şekle metin içinde atıf yapılmalı, şekil ve tablolar yazım alanı içinde olmalıdır. Tüm tablo ve şekiller makale boyunca sırayla numaralandırılmalıdır (Tablo 1, Şekil 1 gibi). Tablo ve şekil başlıkları ve açıklamaları kısa ve öz

olmalıdır. Türkçe sunulan makalelerdeki Tablo ve Şekil başlıklarının İngilizceleri de italik olarak Türkçe başlıkları altında verilmelidir.

Numaralandırma ve açıklama kısımlarında metin "Times New Roman" formatında 12 punto olarak yazılmalı ve görsel ile açıklama satırı arasında boşluk olmamalıdır. Görsel ile önceki ve sonraki paragraflar aralarında birer satır boşluk olmalıdır. Görsel içerisindeki veriler okunaklı olmalıdır. Eğer çalışmanızı İngilizce olarak sunmak istiyorsanız lütfen isimlendirmeleri şekil, grafik ve resim için "figure", harita için "map" olarak değiştirdiğinizden emin olunuz.

Tablo, şekil, grafik ve resim numaralandırmaları ile aynı metin özelliklerinde olmalıdır. Şekil başlıklarından önce ve tablo başlıklarından sonra 6nk boşluk bırakılmalı, Tablo ve şekil başlıkları bir satırdan fazla ise tek satır aralığı yazılmalı ve asılı (2cm) olarak ayarlanmalıdır. Tablo numaralandırılması ve açıklaması; tablonun üstünde olmalı, tablodan önce ve sonraki paragraflar arasında birer satır boşluk bırakılmalıdır.

Tablo dikey çizgi kullanılmamalıdır. Tabloda kullanılan ilk ve son yatay çizgiler 11/2 nk, ara yatay çizgiler 1/2nk kalınlıkta olmalıdır. Tablo içindeki metin okunaklı olmalıdır (8-12 punto kullanılabilir).

Tartışma ve Sonuç (Discussion and Conclusion)

Bu kısımda, çalışmada elde edilen bulguların nedenselliği ilgili bilimsel kanıtlarla tartışılır. Nedenler ve elde edilen bulgular detaylı şekilde yorumlanır. Bu bölümde elde edilen bulguların tekrarı yapılmamalıdır. Ayrıca, çalışmasından elde edilen sonuçların literatüre katkısı, çalışmanın eksiklikleri ile öneriler de yer alabilir. Yazarın isteğine bağlı olarak bu bölüm "Bulgular" kısmı ile birleştirilmesi tercih edilirse "Bulgular ve Tartışma", ayrıca "Sonuç" kısmı makaleye eklenmelidir.

Teşekkür (Acknowledgment)

Bu kısımda; çalışmaya katkısı olan kişi, kurum ve kuruluşlara teşekkür edilir.

Kaynaklar (References)

Metin içerisindeki atıflarda:

· Tek yazarlı çalışmalarda: **Doe (2014) ya da (Doe, 2014)**

· İki yazarlı çalışmalarda: **Doe ve Smith (2014) ya da (Doe ve Smith, 2014)**

· Üç veya daha fazla yazarlı çalışmalarda: **Doe ve ark. (2014) ya da (Doe ve ark., 2014)**

· Aynı yazara ait birden fazla çalışmaya atıf yapıldığında: **Doe ve ark. (1993 ve 1994), Doe ve ark. (1993a ve 1993b)**. şeklinde düzenlenmelidir.

· Çok sayıda çalışmaya yapılan atflar kronolojik olarak sıralanır: (**Doe, 1999; Smith ve Doe, 2001; Doe ve ark., 2014 ve 2015**)

Kaynaklarda verilecek kaynaklar, alfabetik sıraya göre aşağıda örneklerde verildiği biçimlerde eklenmelidir.

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Jackson, P. G. G., Cockcroft, P. D., 2002. Clinical Examination of Farm Animals. Oxford, UK: Wiley-Blackwell. **(Kitap kaynakları bu şekilde verilmelidir.)**

SPSS, 2013. IBM SPSS Statistics 22.0 for Windows. Armonk, NY. **(Paket programlar kaynakları bu şekilde verilmelidir.)**

Young, O. A., West, J., 2001. Meat Color. In Y. H. Hui, W. K. Nip, & R. Rogers (Eds.), Meat Science and Applications (pp. 39-71). Newyork, USA: CRC Press. **(Kitap bölümü kaynakları bu şekilde verilmelidir.)**

Information for Authors

Journal of Animal Science and Products is published 4 times a year (ISSN: 2667-4580). Its short name is JASP. The scope of the journal covers all aspects of animal science and production.

Journal of Animal Science and Products is an open access and an international journal. All issues are freely available without any charge for either user or institution. Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author.

Publication types

The journal publishes original research articles, short communications, scientific reports, case reports, technical notes, letters to the editor, reviews, and, when necessary, research and conference books.

Original (full-length) manuscripts are original scientific papers based on sufficient scientific investigations, observations and experiments. Manuscript consists of the title, abstract and keywords, introduction, material and methods, results, discussion, and references. Manuscript length should not exceed 20 pages. Abstract should contain 300±50 words.

If manuscript is shorter than 6 pages, manuscript will be accepted and published as short communication. It should be prepared in the format of full-length original article but its abstract should not exceed 150 words.

Scientific reports are short description of original research findings. These should be prepared in the format of full-length original articles. The length of scientific reports should be no longer than 6 pages in total.

Case reports are the reports of recent findings encountered in the application, zootechnical and laboratory of related fields. The title and summary of these articles should be written in the format of full-length original articles and the remaining sections should follow introduction, case history, discussion and references. The length of case reports should be no longer than 6 pages in total.

Technical notes are notes on methods or guidance related to animal science and production. The title and summary of these articles should be written in the format of full-length original articles and the remaining sections should follow Introduction, text (with appropriate titles), conclusion, and references. The length of case reports should be no longer than 6 pages in total.

Letters to the editor are short and picture-documented presentations of subjects with scientific or practical benefits or interesting cases. The length of letters should be no longer than 2 pages in total.

Reviews are based on literature regarding a particular subject. The title and summary of this review should be prepared as described for the full-length original articles and the remaining sections should follow Introduction, text (with appropriate titles), conclusion, and references. The length of the text should be no longer than 16 pages in total. Invited reviews have priority for publication.

Manuscript preparation

TEMPLATES FOR UPLOADING FILES

1. As a full article; Author's version of the article,
2. In the additional files section; Author unnamed version of the article,
3. In the Title Page section, the page with the title of the article and the information of all authors,
4. Copyright Transfer Agreement Form
5. Similarity Report (maximum 24%)

Articles to be included in the Journal of Animal Science and Products (JASP) should be written according to the following rules and uploaded online.

1. Our journal accepts both Turkish and English articles. If the writing language of the article is Turkish, the English of the abstract, figure and table names should also be provided. Similarly, Turkish abstracts of English articles should be written. In addition, descriptions of tables and figures should be written in Turkish.

2. The authors are responsible for the compliance of the articles with the ethical rules. The similarity analysis report must be uploaded to the system by the author. References, Article Title, Table and Figure names should be excluded. The similarity rate to other scientific publications should not exceed 24%. However, the editor reserves the right to request an ethics committee document from the authors when necessary.

3. The manuscripts should be written by using Microsoft Office Word program, the article text on the paper in A4 format in Times New Roman type letters (12 pt.) With 1.15 spacing and should not exceed 20 pages. 2.5 cm space should be left on the right, left, bottom and top of the page.

4. The use of resources in the article should be made according to APA.

5. SI (Systeme International d'Units) measurement units should be used in all articles. When abbreviations and symbols are used for the first time in the text, they should be explained. Abbreviations should not be used in the title of the article.

6. Formulas and equations should be numbered and their numbers should be shown in parentheses justified to the right next to the formula.

7. No fee is required from the authors to pay for accepted and published articles.

8. The publishing rights of the articles accepted for publication belong to the institution that publishes the journal. The opinions and suggestions in the articles are entirely the responsibility of the authors.

9. Authors apply for articles online. During the application made through the online application system, the authors will receive a total of 5 files as following;

1. As a full article; Author's version of the article,
2. In the additional files section; Author unnamed version of the article,

3. In the Title Page section, the page with the title of the article and the information of all authors,
4. Copyright Form and
5. Submit the Similarity Report (maximum 24%). Incorrect and incomplete applications will not be evaluated.

10. All authors in the article have the Copyright Form (https://dergipark.org.tr/tr/journal/3237/file/3356/download) state that they have given their publishing rights to the Journal of Animal Science and Products (JASP). All figures and tables in the article should be presented in their relevant places within the article.
11. Authors can upload your articles to our journal by following the steps at https://dergipark.org.tr/en/pub/jasp/page/8770

Rules Regarding Sections of the Manuscript

Article title

The Turkish Title of the Study The First Letter of Each Word (Excluding Conjunctions) and “Times New Roman” should be written in 14 font size.

Author Names

It should be written in "Times New Roman" font in 12 font size.

Author Information

It should be written in "Times New Roman" with 10 font size.

Abstract

It should be written in “Times New Roman” font in 10 font size. In this section, the purpose of the study, the material (s) and method (s) used, the important findings and the conclusion (s) should be stated clearly and concisely. The text should be written in "Times New Roman" font, 10 pt, single line spacing and in one paragraph in accordance with the Turkish spelling rules. Please do not change the writing field borders in right-left directions. The text to be added in this section should be at most (300) words and the cover page should not exceed one page. If you want to present your work in English; The first title, summary and keywords are in English in this section; Provide the Turkish title, summary and keywords in the following section. Do not make changes in the parts containing author names and addresses and date information. When your work is published, the volume, issue, page number and date information will be updated by us. Do not make changes in these parts.

Keywords

"Times New Roman" Font should be written in 10 font size. 4-6 keywords that best describe your work should be added one under the other.

Introduction

It should contain information that prepares the reader for the subject. Check that there is no space before and after the paragraph in the text, with the "Line and Paragraph Spacing" editor, by seeing that the "Before" and "After" values in the "Spacing" section are zero (0) in the "Line Spacing Options" section. Add a space between the "Introduction" title and the text, and add the text by leaving a tab (1.25 cm) space at the beginning of each paragraph in the text under this heading.

Material and Methods

In this section, the number and date of the ethics committee approval document of the study for in vivo studies should be given.

Materials, objects, working area, time and limitations to be worked on should be mentioned in the material. All information related to Table, figure and material etc should be included in this section.

Method, on the other hand, is the technique or techniques used in achieving the purpose of the research. If the method (s) used are new, they should be detailed in a clear and understandable manner. If the method used is a known method, it is sufficient to give its name just by showing the source.

Material and method subtitle (optional)

In this section, if information is given under the subtitle, the subtitle should be written in "Times New Roman", 12 pt, bold and italic. The first letter of the first word of the subtitle should be capitalized and the rest should be in lowercase letters. No spaces should be left after subheadings.

If there will be equations in the text of the work, they should be given in two cells in a single-row table with borders hidden. The equation must be added to the left cell and that cell must be centered. The right cell must contain the equation number and this cell must be right aligned, just large enough to fit the equation number. There should be one line of space between the paragraphs before and after the equation statements.

Results

This section should include the findings obtained and should be supported in figures and tables. No reference should be given in the this section.

All photographs, pictures, drawings and graphics other than the table should be given as "Figure". Pictures, figures and graphics should be clear and suitable for offset printing technique. Each table and figure should be cited in the text, figures and tables should be within the writing area. All tables and figures should be numbered consecutively throughout the article (such as Table 1, Figure 1). Table and figure titles and explanations should be short and concise. Table and Figure titles in Turkish articles should be given in italics under Turkish titles.

In the numbering and explanation sections, the text should be written in "Times New Roman" format in 12 pt. There should be no space between the image and the description line. There should be one line space between the visual and the previous and next paragraphs. The data in the image must be legible. If you want to present your work in English, please make sure to change the naming as "figure" for figure, graph and picture, and "map" for map.

They should have the same text properties as the table, figure, graph and picture numbering. 6 nk space should be left before the figure headings and after the table headings. If the table and figure fish are more than one line, one line spacing should be written and set as hanging (2 cm). Table numbering and explanation; It should be at the top of the table, and there should be one blank line between the paragraphs before and after the table.

Table vertical line should not be used. The first and last horizontal lines used in the table should be 11/2 pt thick, intermediate horizontal lines should be 1/2 pt thick. The text in the table should be legible (8-12 font size can be used).

Discussion and Conclusion

In this section, the causality of the findings obtained in the study is discussed with relevant scientific evidence. Causes and findings are interpreted in detail. The findings obtained in this section should not be repeated. In addition, the contribution of the results obtained from the study to the literature, the deficiencies of the study and suggestions may also be included. If it is preferred to combine this section with the "Results" section, depending on the author's request, "Results and Discussion", as well as the "Conclusion" section should be added to the article.

Acknowledgments (Acknowledgment)

In this section; We would like to thank the people, institutions and organizations that contributed to the study.

References

In the citations in the text:

· In studies with a single author: **Doe (2014) or (Doe, 2014)**

. In studies with two authors: **Doe and Smith (2014) or (Doe & Smith, 2014)**

· In studies with three or more authors: Doe et al. (2014) or (Doe et al., 2014)

· When citing more than one study by the same author: **Doe et al. (1993 and 1994), Doe et al. (1993a and 1993b).** should be arranged as.

. Citations to a large number of studies are listed in chronological order: **(Doe, 1999; Smith & Doe, 2001; Doe et al., 2014 and 2015)**

The references to be given in the references should be added in alphabetical order as given in the examples below;

Aksakal, V., Macit, M., Esenbuğa, N., 2009. Effects of various ages of weaning on growth characteristics, survival rate and some body measurements of Awassi lambs. Journal of Animal and Veterinary Advances. 8(8): 1624-1630. (**Full text articles should be given in this way.**)

AOAC, 2000. Official Methods of Analysis (17th Ed.). Maryland, USA: Association of Official Analytical Chemists. (**Books with an unknown author should be given in this way.**)

Arıkan, S., Sağıroğlu, G., Yıldız, S., Turgut, D., 1994. Determination of fungi isolated from some animal feeds and their toxins by biological measurement method. XII. National Biology Congress. Molecular Biology, Genetics and Microbiology Section Proceedings Book, Volume V. Edirne, 25-27 May 1994, p. 48-54. (**Symposium papers should be given in this way.**)

Çetin, F., 2011. Feed additive distilled grains (DDGS). http://www.tepge.gov.tr/Dosyalar/Yayinlar/719e2ab765e04a0ebdd00839c3505b44.pdf Date of access: 16.06.2016. (**Internet address resources should be given as such.**)

Dikmen, İ., 1968. Research on rooting olive cuttings. Master Thesis. Ege University, Institute of Science, 98 p. (**Thesis should be given in this way.**)

Jackson, P. G. G., Cockcroft, P. D., 2002. Clinical Examination of Farm Animals. Oxford, UK: Wiley-Blackwell. (**Book sources should be given in this way.**)

SPSS, 2013. IBM SPSS Statistics 22.0 for Windows. Armonk, NY. (**Softwares should be given in this way.**)

Young, O. A., West, J., 2001. Meat Color. In Y. H. Hui, W. K. Nip, & R. Rogers (Eds.), Meat Science and Applications (pp. 39-71). Newyork, USA: CRC Press. (**Book chapters should be given in this way.**)

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