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Micronutrient correction and concurrent iatrogenic obesity in captive desert antelope

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Abstract

Micronutrient deficiencies and subsequent obesity pose complex challenges to the long-term health and conservation success of captive ungulates. This study assessed the nutritional and metabolic status of three desert antelope species Arabian oryx (Oryx leucoryx), addax (Addax nasomaculatus), and scimitar-horned oryx (Oryx dammah) maintained under human care between October 2024 and April 2025. Initial blood analysis October 2024 identified widespread deficiencies in Zinc (Zn), Copper (Cu), and Selenium (Se), leading to the implementation of targeted supplementation. By April 2025, while serum levels of Vitamin A, Vitamin E, and Selenium were successfully optimized or over-corrected, deficiencies in Copper and Zinc persisted in several individuals, indicating incomplete resolution. Critically, during this six-month period, the average body weight of the cohort increased by 20%, driven by individual gains up to 58.1% and corresponding increases in Body Condition Score (BCS) up to 8/9 (Fat). This weight gain was attributed to five keys, interacting factors: overestimation of baseline body weight for feed calculations, inappropriate hay-to-concentrate ratios, low energy expenditure in captivity, social dominance at feed stations, and compensatory growth following mineral correction. To address this, a revised management plan focusing on precision-feeding based on actual body weight, and the seasonal elimination of high-energy pelleted feeds, is now in place. This case underscores the necessity of accurate individual-level metabolic data, balanced energy allocation, and social dynamics assessment to prevent iatrogenic obesity while managing micronutrient health in conservation programs.

Keywords: arabian oryx, addax, scimitar-horned oryx, vitamin deficiency, micronutrients, obesity, captive management, diet formulation, summer diet

Introduction

Effective management of desert antelope species requires careful alignment of micronutrient adequacy with controlled energy intake. Deficiencies in essential vitamins and trace minerals are well recognized to impair immune competence, reproductive performance, and overall maintenance of animal health.[1] In contrast, inaccurate estimation of dietary requirements, ingredients and feed allocations can result in excessive energy intake and subsequent obesity, an increasingly documented challenge in conservation-based animal management.[2] The Arabian oryx (*Oryx leucoryx*), addax (*Addax nasomaculatus*), and scimitar-horned oryx (*Oryx dammah*) represent regionally significant ungulate species maintained in Dubai safari park collections for conservation, research, and educational objectives. This study describes the detection and correction of multiple micronutrient deficiencies within these species, while also highlighting the unintended development of obesity, arising from a combination of dietary, behavioral, seasonal environmental and management-related factors.

Material and methods

Study subjects and housing

The study involved individuals from captive populations of Arabian oryx, addax, and scimitar-horned oryx housed at the facility.

Arabian oryx: Housed in mixed-sex, mixed-species groups within the Explorer Village (males) and Arabian Village (females with Arabian gazelles) habitats.

Scimitar horned oryx: Housed in smaller yard enclosures, typically in bachelor groups or breeding groups, leading to varying social densities.

Addax: The male, housed with two others in Yard, dominated the feed station Even after 7.1 individuals were added to the group in October, he continued his dominance. The previous diet, which was 4% of body weight and contained an excessive proportion of pelleted feeds and hay, combined with low activity and increased intake, led to his obesity. The standard diet, 3% of body weight, was implemented for

this group starting in June. The female was pregnant and BCS increase due to pregnancy. All Animals were managed under standardized husbandry protocols. Access to holding pens with feed troughs and exhibit space varied between groups, impacting energy expenditure and social access to feed.

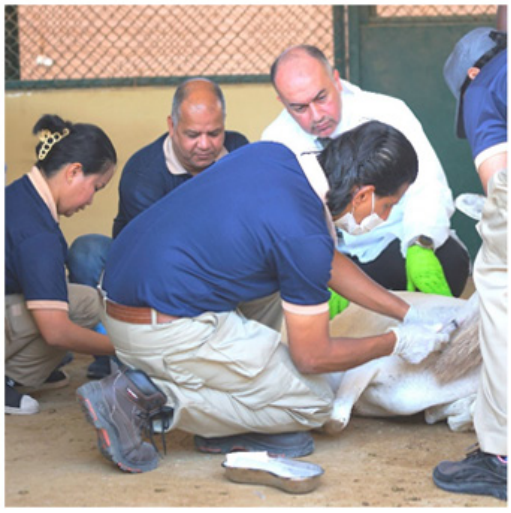
Data collection and analysis

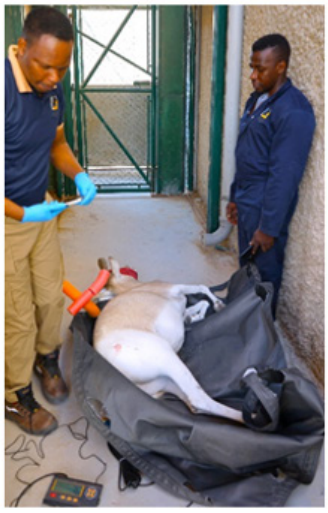
Physical and physiological data were collected during two scheduled veterinary sessions: October 23, 2024 (Baseline) and April 20, 2025 (Post-Supplementation).

I. **Blood sampling:** Performed by trained veterinary professionals to assess serum concentrations of key vitamins (A, E) and trace minerals (Cu, Se, Zn).

II. **Body condition scoring (BCS):** Conducted by veterinary staff using established species-specific scales (5-point for Arabian oryx; 9-point for addax and scimitar-horned oryx).

III. **Body weight:** Measured using calibrated scales.





Dietary assessment

Initial diet allocation was based on an estimated 4% of assumed body weight (as-fed basis), consisting of a mix of pelleted feed (41% dry matter contribution), hay (48% dry matter), and fresh forage (11% dry matter). The micronutrient supplementation program, targeting the identified deficiencies, was implemented in November 2024.

Results

Micronutrient status and response to supplementation

Initial blood tests (October 2024) confirmed deficiencies in Copper, Selenium, and Zinc across the cohort. Following six months of targeted supplementation, the mineral status showed a mixed response, as detailed in Table 1.

Table 1 Micronutrient Status Pre- and Post-Supplementation (October 2024 vs. April 2025)

Species	Mineral	Reference(umol/L)	Oct 2024 Result	Apr 2025 Result	Final Status (April)
	Copper (Cu)	12.0–16.0	7.4 (Low)	13.90 (Optimal)	Corrected
Scimitar Oryx	Zinc (Zn)	10.0–30.0	8.3 (Low)	10.10 (Optimal)	Corrected
	Selenium (Se)	1.2–1.5	1.1 (Low)	1.87 (High)	Over-corrected
	Copper (Cu)	12.0–16.0	10.40 (Low)	4.90 (Low)	Uncorrected/Worse
Arabian Oryx	Zinc (Zn)	10.0–30.0	3.10 (Low)	4.30 (Low)	Uncorrected
	Selenium (Se)	1.2–1.5	1.03 (Low)	1.53 (High)	Over-corrected
	Copper (Cu)	12.0–16.0	5.80 (Low)	10.60 (Low)	Uncorrected
Addax	Zinc (Zn)	10.0–30.0	9.30 (Low)	9.00 (Low)	Uncorrected/Worse
	Selenium (Se)	1.2–1.5	1.08 (Low)	1.69 (High)	Over-corrected

Overall, while Vitamin A and Vitamin E status was optimized across all individuals, Copper and Zinc levels remained below the reference range in the Arabian Oryx and Addax groups, indicating the supplementation strategy requires modification.

Body weight and body condition changes

Despite stable environmental conditions and successful correction of several micronutrients, the cohort experienced significant, unintended weight gain, averaging 20% across the species.

The most extreme changes were observed in the Arabian Oryx female and the Addax male, who gained 58.1% and 35.7% of their initial body weight, respectively, leading to final BCS classifications of 'Obese' (5/5) and 'Fat' (8/9). The Scimitar Horned Oryx female was the only individual to show intentional weight reduction (-9.0%), moving from Obese (8/9) to Moderate Fat (6/9) Table 2.

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Table 2 Individual Body Weight and Body Condition Score (BCS) Changes

Species	Sex	Oct 2024 BW kg	Apr 2025 BW kg	Variation of BW in kg	Variation of BW in %	BCS Oct 2024/ Apr 2025	Final Status
Scimitar Oryx	Male	120	137	17	14.20%	5/9 to 7/9	Moderate Fat
Scimitar Oryx	Female	148	134.7	-13.3	-9.00%	8/9 to 6/9	Weight Loss Achieved
Arabian Oryx	Male	97.5	102	4.5	4.60%	3/5 to 4/5	Moderate Fat
Arabian Oryx	Female	74	117	43	58.10%	3/5 to 5/5	Obese
Addax	Male	77	104.5	27.5	35.70%	5/9 to 8/9	Obese
Addax	Female	85	98	13	15.30%	6/9 to 8/9	Moderate Fat

Discussion

Multifactorial drivers of obesity

The dramatic increase in body weight, concurrent with mineral management, highlights the multifactorial etiology of obesity in these captive species. We identified five primary contributing factors:

I. **Inaccurate body weight estimation:** Diet calculations were based on grossly overestimated body weights (e.g., Addax females assumed to be 100 kg but averaging 78 kg). This led to substantial over-allocation of feed, generating chronic energy surplus.

II. **Inappropriate diet composition:** The proportional dry matter composition (41% pelleted feed vs. 48% hay) provided an excessive energy density, shifting the diet away from the high-fiber, low-energy profile typical of wild grazing species.

III. **Compensatory growth:** The correction of chronic Vitamin A, E, Cu, and Zn deficiencies likely influenced metabolic homeostasis, leading to improved feed utilization, stronger bone/muscle development, and enhanced appetite, triggering rapid, compensatory body mass gain.

IV. **Reduced energy expenditure:** The confined nature of the captive enclosures prevents the long-distance foraging and anti-predator locomotion required in wild habitats, further exacerbating the energy imbalance.

V. **Social dynamics:** Dominant individuals, particularly the Addax male and a key female in the Arabian Oryx group, monopolized feed troughs, ensuring their disproportionate intake of the high-energy diet.

Revised dietary strategy and future management

To address the persistent energy imbalance and obesity risk, a revised feeding plan has been developed based on precise energy calculations using actual body weights, activity levels, and metabolic requirements.

A critical component of this strategy is the seasonal reduction of energy density:

I. **Summer diet modification:** Pelleted feeds will be eliminated during the summer months, which is projected to reduce the total dietary energy kcal by 25–50% while maintaining essential micronutrient supply through separate, targeted supplementation or mineral blocks.

II. **Precision feeding:** diet quantity will be calculated based on individual, measured body weight (not estimates) and adjusted based on bcs and physiological state e.g., pregnancy.

III. **Social mitigation:** Management strategies, such as increasing the number of feed stations and providing feed across a wider area, will be implemented to reduce monopolization by dominant individuals.[3–6]

Conclusion

Targeted supplementation successfully resolved deficiencies in key vitamins and mineral markers in the initial six-month period. However, this success was overshadowed by an average 20% increase in body weight across the cohort, driven by systemic flaws in diet formulation and feed allocation. This study confirms that micronutrient correction in managed populations must be coupled with rigorous control of energy intake. Future management protocols will emphasize a precision-feeding approach that incorporates physiological metrics, breeding cycles, seasonal climatic changes, and accurate energy requirement calculations for refined diet formulations. The seasonal discontinuation of pelleted feeds during summer is mandated to mitigate obesity risks and ensure the long-term metabolic health required for conservation-focused breeding control.

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Conflicts of interest

None.

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