

Evidence-based practice

Supportive nutrition for elderly chimpanzees: a case study on non-invasive supplementation in a group setting

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Abstract

Ageing chimpanzees *Pan troglodytes* in zoological settings often experience physiological decline, including loss of body condition and muscle mass, which can negatively impact welfare and longevity. Over a three-year period, three elderly chimpanzees at Antwerp Zoo exhibited rapid and unexplained deterioration in body condition, whereas other group members remained in good health. Despite comprehensive diagnostic evaluations, including blood analyses and cardiac assessments, no underlying medical cause was identified. Given the importance of maintaining social bonds in older chimpanzees, individual intervention was implemented without disrupting group structure or routines. A high-protein, energy-dense, lactose-free shake was formulated to provide supportive nutrition, incorporating whey protein, rice milk, both soluble and insoluble fiber, and omega-3-rich fats, delivering approximately 1837 kJ ME per portion. The shake was administered individually as part of an established routine involving indoor herbal tea distribution, minimizing disruption and competitive behaviours. All three individuals showed marked improvement in body condition scores (from 2.0–2.5/10 to 3.8–4.2/10) over several months, alongside improved coat quality and increased alertness or activity. The intervention proved feasible, non-invasive, and socially compatible, offering a promising approach to geriatric care in great apes. However, long-term effects of sustained protein-rich supplementation remain unknown. Further research is needed to evaluate its impact on overall dietary intake and to determine its applicability across other great ape species.

Background

As they age, chimpanzees *Pan troglodytes* in zoos undergo various physiological changes that affect their health and overall well-being. As in other animals, one likely age-related change in chimpanzees is a decline in the digestive tract's efficiency in absorbing nutrients, resulting in reduced energy and nutrient availability. Cognitive function also tends to decline with age, leading to reduced sensory perception and mental abilities (Brando and Chapman 2023; Krebs et al. 2018). Dental issues are frequent in older animals, and worn or damaged teeth can interfere with proper feeding and nutrition (Kilgore 1989; Lowenstine et al. 2016). Additionally, many ageing animals experience increased inflammation, particularly in the joints, which can lead to arthritis and reduced mobility (Lowenstine et al. 2016). Changes in group social structure may also occur, sometimes limiting access to food for certain individuals (Baker 2000; Thompson González et al. 2021).

As a result of ageing, symptoms such as muscle mass loss, reduced activity levels, and slower reaction times may be observed. Over the past three years, three elderly chimpanzees housed at Antwerp Zoo showed rapid weight and muscle loss, whereas their group members remained in good health. Thorough blood analyses and cardiac evaluations revealed no clear diagnostic cause. Rapid deterioration in animals may indicate that they are approaching the end of life, raising important questions regarding their quality of life and the appropriateness of humane euthanasia (Chapman et al. 2023). However, euthanasia in great apes remains a significant ethical dilemma within zoological institutions. The decision is often complicated by the strong social bonds these animals form and their high cognitive abilities, making end-of-life decisions particularly sensitive (Matsuzawa 2016). To reduce stress and competition, some facilities choose to house older animals separately. While well-intentioned, this can clash with the deeply social nature of these species and may lead to feelings

of isolation. Research shows that older chimpanzees still display social bonding behaviours at similar levels to their younger counterparts, underscoring how important it is to support social connections in their later years (Baker 2000). Because it would be unethical to let the animals decline without help, supportive feeding was introduced for the three elderly chimpanzees at Antwerp Zoo.

Actions

In all three cases, supportive nutrition was provided individually without separating the animals from the group. Since the chimpanzees were already accustomed to receiving herbal tea individually in their indoor enclosures, caregivers used this opportunity to offer nutritional support. While the rest of the group received their usual tea, the elderly chimpanzee was given a specially formulated shake. This approach allowed the caregivers to provide extra nutritional support separately, without drawing attention or encouraging begging behaviour from other group members.

Although an inadequate overall dietary intake — including insufficient energy, vitamins, and minerals — can contribute to muscle loss, low protein consumption is a well-known issue in older humans and is considered a key target for intervention (Boirie et al 2014; Waters et al. 2010). With this in mind, the aim was to develop a protein-rich, energy-dense diet to support muscle and weight gain and overall well-being. As ageing often leads to reduced protein absorption (Hinszen et al. 2024), it was important to select a protein source that is both easy to digest and highly effective. Whey protein is widely recognised for its high biological value and its well-balanced amino acid profile. It is rapidly absorbed and particularly rich in branched-chain amino acids such as leucine, which plays a critical role in stimulating muscle protein synthesis (Ha and Zemel 2003; Lancha et al. 2017).

Rice milk was selected as the base for the supportive shake because it is lactose-free and easier to digest. Although lactose intolerance is not specifically documented in chimpanzees, it has been reported in humans and captive macaques (Hart et al. 1980; NRC 2003; Streett and Jonas 1980). To avoid any potential digestive issues, we excluded lactose as a precautionary measure. Egg yolk was added to the supportive shake for its high nutrient density and wide range of health benefits. It provides essential vitamins (A, D, E, K, and B vitamins), mainly unsaturated fats for energy, and important trace minerals such as zinc and selenium that support immune and antioxidant functions (Kaur et al. 2019; Réhault-Godbert et al. 2019). Linseed was added to provide omega-3 fatty acids, which are known for their anti-inflammatory benefits. Dietary fibre was included in the shake to enhance gut health and support digestive function, which plays a key role in overall well-being in chimpanzees as in other animals (Cabana et al. 2018; Kišidayová et al. 2009). Inulin powder, a soluble fibre with well-established prebiotic effects in humans and monogastric animals, was added to promote the growth of beneficial microbes, which ferment the fibre to produce short-chain fatty acids that protect gut barrier integrity and, in turn, support overall immune function (Kozłowska et al., 2016; Le Bastard et al., 2020). Cellulose, an insoluble fibre and the primary structural component of plant cell walls, is characterised by low water solubility, high waterholding capacity, and slow fermentability. Cellulose powder was added to support digestion by promoting regular bowel movements, improving faecal consistency, and stimulating healthy fermentation in the hindgut (Baky et al. 2024). In addition to supporting digestion, dietary fibre has been shown to reduce systemic inflammation. This is particularly important in ageing individuals, as chronic inflammation can negatively affect muscle mass and protein synthesis. By helping to manage inflammation,

Table 1. Recipe for daily dose of nutritional support shake formula for elderly chimpanzees *Pan troglodytes*

Ingredient	Quantity
Whey Protein (100% natural, vanilla flavor)	40 g
Rice Milk (unsweetened)	244 g
Egg Yolk (fresh or boiled)*	1 unit
Linseed Oil	1 tablespoon (≈13.5 mL)
Organic Inulin Powder	5 g
Dietary Fibre (Cellulose)	5 g

*Egg Yolk can be boiled to reduce the risk of Salmonella infection. This process does not significantly reduce the fat- and water-soluble vitamin content of the egg yolk (Wang et al. 2023).

fibre contributes indirectly to preserving muscle health (Montiel-Rojas et al. 2020).

Although the ingredients were carefully selected, the exact quantities used were based on informed estimates. The shake was formulated so that the overall diet would still fall within the recommended reference ranges if the basic diet was fully consumed— which was unlikely. The shake provided 1837 kJ ME (440 kcal ME) and contained about 31% crude protein, 17% fat, and 8% crude fibre, all measured on a dry matter (DM) basis. A single portion of the shake was divided into two daily servings, and the recipe can be found in Table 1.

Consequences

The first chimpanzee, aged 31, showed signs of malnutrition with a body condition score of 2.5/10 (Reamer et al. 2020). She was the only one of the three animals whose low body condition score could be attributed to a suspected illness. Believed to have impaired vision, she spent significantly less time foraging and eating than the rest of the group. The shake was gradually introduced over three days, and following the addition of one portion to her diet, her body condition score improved to 4/10 over six months. A progression of her weight could not be measured, as there were no scales available at the time. Her coat quality also improved, and caretakers noted increased alertness. Due to the suspicion of vision impairment, the shake supplementation was not reduced, and her condition remained stable (Figure 1).

A comparative pathology study of ageing great apes reported that many elderly zoo-housed individuals maintained substantial muscle mass and tone despite chronic and serious health conditions (Lowenstine et al. 2016). In contrast, our observations of the other two elderly chimpanzees revealed a rapid decline in body weight and muscle mass, indicative of malnutrition. Although we could not confirm disease-associated cachexia due to the absence of a clear underlying pathology, the clinical signs strongly pointed to nutritional insufficiency. This may have been related to age-associated difficulties in locating, consuming, or properly digesting food.

The second chimpanzee, a 44 year old female, had been slightly underweight for an extended period. However, she then experienced a sudden and concerning decline, marked by rapid weight loss and a noticeable reduction in muscle mass. This

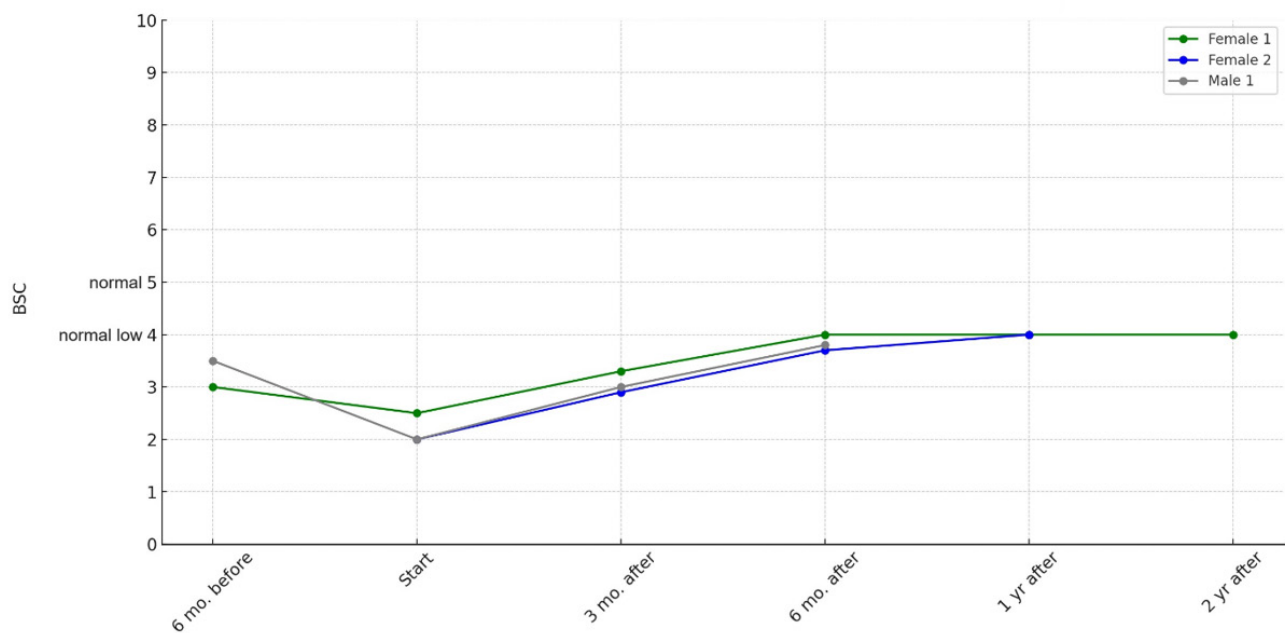


Figure 1. Progression of body condition scores in three elderly chimpanzees receiving a protein-rich, energy-dense supportive shake in addition to their standard daily diet.

deterioration resulted in a body condition score of 2/10, indicating a severely compromised physical state. To investigate potential underlying causes, blood tests and a thorough cardiac examination were performed. However, these revealed no abnormalities or clear medical explanations for her condition. Initially, she was given one portion of the nutritional shake daily. After one month of supplementation with only minimal improvement, the daily portion was increased to 1.5 times the original amount in an effort to accelerate her recovery. Following this adjustment, she began to show gradual but steady signs of improvement. Her body condition score increased, her previously apathetic behaviour diminished, and her muscle mass was significantly rebuilt over time (Figure 2). Her current body condition score is stable at 4.2/10, and she continues to receive one portion of the shake daily as part of her ongoing nutritional support. The third chimpanzee, a 40 year old male, experienced a similar sudden drop in body condition without an identifiable medical cause. He responded to two portions of the shake and has been on this regimen for six months, with his current body condition score at 3.8/10. During this time, we had access to scales, and his weight gradually increased from 42.7 kg to 45.7 kg and then to 47.7 kg over the six month period.

Although the shake was initially intended to help the animals regain strength and reach an acceptable weight, it has not yet been fully phased out. In the case of the chimpanzee suspected of partial blindness, continued supplementation still seems appropriate. However, for the other two chimpanzees, it is worth questioning whether the ongoing administration of the shake might be causing them to eat less of the standard diet offered to the entire group. Observational studies are therefore needed to

assess whether continued supplementation of the shake is indeed the most appropriate strategy. Furthermore, the absence of a clear diagnosis explaining the animals' rapid loss of condition makes zoo staff reluctant to fully phase out the shake, as the underlying cause remains unknown.

Another point to consider is the choice of whey protein. This animal-based protein was preferred due to its high digestibility and well-known effects on stimulating muscle protein synthesis (Ha and Zemel 2003; Lancha et al. 2017). However, plant-based proteins such as pea protein may provide comparable benefits and could potentially be more suitable for this frugivorous species (Tweheyo and Lye 2005; Wats et al. 2012). Although the supportive feeding shake had positive effects on body condition, muscle mass, and coat quality in all three individuals, long-term effects of this protein-rich shake remain insufficiently understood. Regular blood tests would be valuable for monitoring purposes; however, one might question the relevance of potential long-term effects given the advanced age of these animals. Additionally, blood sampling often requires the animals to be anaesthetised, which is not ideal and carries its own risks, particularly in older individuals.

The current study shows that the geriatric shake was effective in improving the body condition of elderly chimpanzees without the need to intervene in their social group structure or daily routines. This nutritional intervention offers a non-invasive, welfare-friendly strategy to support ageing chimpanzees experiencing unexplained physical decline. Given its composition and practical applicability, this shake may also be beneficial for other great ape species facing similar age-related challenges.

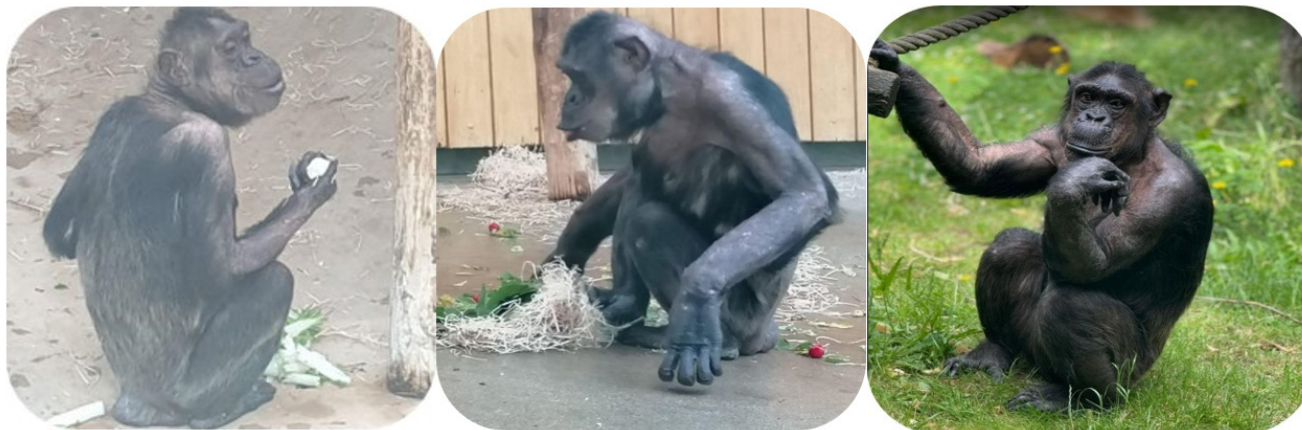


Figure 2. Female 2 before the start of the supportive shake (left and middle) and one year after the start of the shake (right) Photos: Melanie Vanhulle.

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