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Palak Gupta
Department of Animal
Nutrition, College of Veterinary
and Animal Science, Bikaner,
Rajasthan, India

Health benefits of linseed (*Linum usitatissimum*) oil for racing and breeding horses: A review

Palak Gupta

Abstract

The beneficial effects of its biologically active substances, specifically omega-3 polyunsaturated fatty acids, have made linseed oil a staple of animal and human nutrition for decades. This review explains the role of linseed oil as a source of omega-3 fatty acids to improve performance and semen quality of racing and breeding horses. Comprehensive information elaborated in this review is believed to promote the use of linseed oil.

Keywords: Linseed, omega 3 fatty acids, pufa, health benefits

Introduction

Horses are utilized for races, polo and various equestrian sports all across the world. They have a special significance since they support army, racing business, and police department with services related to mobility, riot control, and patrolling. These draught animals, sometimes known as the "beasts of burden", are the power engine of rural India's economy. *Linum usitatissimum*, also known as linseed, is an annual cultivar that belongs to the Linaceae family (Freeman *et al.*, 1995) [4]. According to Rubilar *et al.* (2010) [21], Canada is the most prominent source of linseed production, followed by China, the United States, and India. Linseeds (also known as flaxseeds) are the only vegetable source of essential fatty acids and has been used for ages as a dietary supplement for horses, because it is a rich source of omega-3 fatty acid: α -linolenic acid (ALA), short chain polyunsaturated fatty acids (PUFA), soluble and insoluble fibers, phytoestrogenic lignans (secoisolariciresinol diglycoside-SDG), proteins and an array of antioxidants (Singh *et al.*, 2011; Oomah, 2001) [24, 13]. Moreover, linseeds are a good choice, because their Omega 3 to 6 ratio (4:1) is very similar to that of grass, the natural diet of the horse so linseed oil provides a 'natural' way to keep the levels of omega 3 in a horse's diet (Richards N, 2014) [18]. Omega-3 fatty acids are beneficial to both animals and humans, and can be utilized in equine nutrition in many ways.

Benefits of linseed oil for Racing horses

Vegetable oils like soybean, corn, and linseed oil are widely utilized in racing horse industry to improve energy density of diet and to supply necessary fatty acids. The health food market has become more familiar with linseed oil as a functional food because of its reported health benefits in recent years. According to Pilar *et al.* (2017) [17], linseed oil has an advantage over other vegetable oils because of its high concentration of omega-3 polyunsaturated fatty acids (PUFA), particularly alpha-linolenic acid (ALA), of which it is the richest plant source. Alpha-linolenic acid is almost 60% in linseed oil, while other plant oils contain only 25% of it. (Nykter *et al.*, 2006) [12].

Frequent supplementation with linseed oil can aid in suppressing inflammatory and allergic reactions, improving the blood lipid profile, increasing tissue sensitivity to insulin, and proving effective in preventing diabetes. (Shahidi *et al.*, 2018) [22]. The biologically component of linseed oil is also reported to lower serum cholesterol and triglyceride levels (Cunnane *et al.*, 1993) [3]. Omega-3 supplementation can lower the likelihood of heart disease, cancer, chronic lung disease, chronic arthritis, Digestive disorders and other inflammatory and immune-mediated diseases in humans (Simopoulos, 2008) [23]. The presence of lignans in linseed can help reduce cancer risk by reducing biochemical factors that are associated with the disease. (Kimura Y, 2001) [9].

Corresponding Author:
Palak Gupta
Department of Animal
Nutrition, College of Veterinary
and Animal Science, Bikaner,
Rajasthan, India

Supplementation of linseed oil improves skin barrier function (Neukam K, 2010) ^[11]. So, it is also marketed for enhancing shine in coat of racing horses and is generally used as skin and hoof conditioners.

Like other animals, horses cannot produce their own PUFAs and must depend on PUFA precursors in their diet. (Trillaud-Geyl *et al.*, 2015) ^[25]. The structure and function of the cell membrane are greatly influenced by polyunsaturated fatty acids (PUFAs), which are important constituents of phospholipids in cell membranes (Lands, 2005) ^[10]. Pathogenesis of many inflammatory and immune mediated diseases is promoted when omega-6 PUFA's are present in excess while increased concentration of Omega-3 fatty acids (and hence a lower n-6 to n-3 ratio) have shown to suppress these pathogenic diseases (Parsons *et al.*, 2011) ^[15]. By supplementing Omega-3 fatty acids, the production of inflammatory mediators namely Prostaglandin E₂, leukotrienes (4-series), and the pro-inflammatory cytokines (especially TNF- α) is decreased. As inflammation forms the foundation for many chronic diseases in racing horses, omega-3 fatty acid supplementation could offer a form of prevention. Moreover, the inflammatory properties of eicosanoids produced from omega-3 fatty acid precursors are lower compared to those produced from omega-6 fatty acid precursors. (Parsons *et al.*, 2011) ^[15]. This alteration in the type of inflammatory products produced may be useful in treating inflammatory diseases. Due to their potent anti-inflammatory and antioxidant effects, omega-3 supplementation have been demonstrated to improve immune function in a number of animal studies (Simopoulos, 2008) ^[23].

Regarding the benefits of linseed oil to improve digestion in racing horses, linseed oil is known to increase the frequency of bowel movements and may provide relief from constipation in horses. In addition, the small stomach of horses compared to the rest of their digestive tract restricts their ability to consume a large amount of food at once. To meet the work loads and energy demands of performance horses, they need more digestible energy sources in their diet. So, supplementation of fat in the form of Linseed oil is becoming more widely used concentrated source of energy to boost the energy density of diet for horses subjected to intense training and work (Hughes *et al.*, 1995) ^[8].

Benefits of linseed oil for Breeding Horses

The maintenance requirements of a mature stallion during the off-season are 25% higher than those of breeding stallions on average. Fat/oil-supplemented diets can be very effective and beneficial for stallions in meeting the increased nutrient requirements of the breeding season, which can assist in their reproductive capacity.

Improving semen quality through dietary inclusion of omega - 3 fatty acids sources has received research interest. According to Arruda *et al.* 2010 ^[1], semen from all domestic species contain high levels of PUFA, in particular, docosahexanoic acid (DHA, an omega-3 fatty acid) and docosapentaenoic acid (DPA, an omega-6 fatty acid). The majority of mammals have docosahexanoic acid as the main PUFA component of their spermatozoa membrane, but spermatozoa of stallion and boars have a greater amount of docosapentaenoic acid (Parks J.E. and Lynch D.V., 1992) ^[14]. Semen quality and fertility are greatly influenced by the ratio of DHA and DPA within the sperm membrane. (Rooke *et al.*, 2001) ^[20].

Several efforts have been made over the years to improve male fertility in the equine species, which has peculiar

features in its sperm biology (Griffin *et al.*, 2019) ^[6]. Supplementation of PUFA's ensure that sperm membrane has the required fluidity for the events related to its fusion during the fertilization process and in this way they offer great benefits to reproductive capability of horses. The integrity, motility, and viability and cold sensitivity of sperm membrane are also impacted by these polyunsaturated fatty acids. (Robinson *et al.*, 2006) ^[19]. Total sperm volume/output and the percentage of normal sperm can also be improved by supplementation omega-3 fatty acids (Harris *et al.*, 2005) ^[7]. Adding dietary pufas to the diet of horses can lead to enhanced semen DHA levels, increased total sperm motility (when cooled and stored for 48 hours) and also improved total and progressive motility in horses. (Brinsko *et al.*, 2005) ^[2].

The use of cooled and frozen/thawed semen offers many advantages to breeders. However, the sperm of some stallions is unable to withstand the stresses of cooling, storage, freezing and thawing. Through proper dietary manipulation, equine spermatozoa's quality and viability could be improved, allowing them to be commercially viable for cooling or cryopreservation. (Grady *et al.*, 2008) ^[5]. The lipid composition of breeding stallions' sperm may be modified and their cryosurvival may increase with the addition of linseed oil to their diet. (Brinsko *et al.*, 2005) ^[2]. Because cooling and freezing processes, can damage the spermatozoa irreversibly due to low temperature shock and may add to lipid peroxidation of sperm membrane leading to oxidative damage causing a decline in spermatozoa lifetime and fertility, with harmful reflections on artificial insemination pregnancy rates (Pena *et al.*, 2019) ^[16].

Conclusion

Omega-3 fatty acids supplementation in horses could be helpful in managing chronic inflammatory conditions and improving the longevity of sport/racing horses. In breeding horses, the use of omega-3 supplementation through linseed oil has also shown beneficial effects on sperm output and dynamics. This review has therefore, described that dietary inclusion of Linseed oil exerts a favourable effect on overall health and improves semen quality in racing and breeding horses.

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