



Estonian University of Life Sciences

Institute of Veterinary Medicine and Animal Sciences

Kiia Greta Isotalo

**THE USE OF EQUINE NUTRITIONAL SUPPLEMENTS IN
FINLAND**

HOBUSTE TOIDULISANDITE KASUTAMINE SOOMES

Graduation Thesis in Veterinary Medicine

Supervisors: Toomas Orro DVM, PhD

Tartu 2019

LIST OF ABBREVIATIONS

BW = Body weight

CK = Creatinine kinase

CO = Carbon monoxide

CS = Chondroitin sulfate

GU = Glucosamine

HA = Hyaluronic acid

LPPC = Lyophilized products of *Perna canaliculus*

MSM = Methylsulfonylmethane

OA = Osteoarthritis

ROS = Reactive oxygen species

ABSTRACT



Estonian University of Life Sciences Kreutzwaldi 1, 51014, Tartu Estonia		Abstract of Final Thesis	
Author: Kiia Greta Isotalo		Curriculum: Veterinary Medicine	
Title: The use of equine nutritional supplements in Finland			
Pages: 40	Figures: 2	Tables: 5	Appendixes: 3
Chair: Chair of Clinical Veterinary Medicine			
Field of research and (CERC S) code: 3. Health, 3.2. Veterinary Medicine B750 Veterinary medicine, surgery, physiology, pathology, clinical studies			
Supervisor(s): Toomas Orro DVM, PhD			
Place and year: Tartu 2019			
<p>The use of nutritional supplements is widespread within many horse owners and caretakers, despite the fact that the scientific evidence of their efficacy is often limited. This study aimed to describe the use of nutritional supplements in horses by the Finnish equestrian industry through an online survey. Most Finnish horse owners or caretakers participating in the study used nutritional supplements in their horses, with only 0.5% of respondents having not used any supplements. The most common types of supplements used were vitamins and minerals, electrolytes and enhancing performance, and joint health and mobility promoting products. After feeding a certain nutritional supplement the majority of participants noticed either a significant or slight improvement in their horse (46.3% and 39.8% respectively). It was also common to feed the horse more than one supplement concurrently and dosage of the supplement was most often based on the manufacturer recommendations. The most common reason for feeding supplements was fulfilling dietary requirements.</p>			
Keywords: horse, dietary requirements, feeding, management, survey			

LÜHIKOKKUVÕTE

Eesti Maaülikool Kreutzwaldi 1, 51014, Tartu		Lõputöö lühikokkuvõte	
Autor: Kiia Greta Isotalo		Õppekava: Veterinaarmeditsiin	
Pealkiri: Hobuste toidulisandite kasutamine Soomes			
Lehekülgi: 40	Jooniseid: 2	Tabeleid: 5	Lisaid: 3
Õppetool: Kliinilise veterinaarmeditsiini õppetool			
ETIS-e teadusvaldkond ja CERC S-i kood: 3. Terviseuuringud, 3.2 veterinaarmeditsiin B750 Veterinaarmeditsiin, kirurgia, füsioloogia, patoloogia, kliinilised uuringud			
Juhendaja(d): Toomas Orro DVM, PhD			
Kaitsmiskoht ja -aasta: Tartu 2019			
<p>Toidulisandite kasutamine on hobuseomanike ja hooldajate seas laialt levinud sellegipoolest, et teaduslik tõestus nende efektiivsusest on tihti vähene. Selles uuringus kirjeldatakse toidulisandite kasutamist Soome hobustel internetipõhise küsitlusega kogutute andmete alusel. Suurem osa Soome hobuseomanikest ja hooldajatest, kes osalesid küsitlusel, kasutasid toidulisandeid, ainult 0.5% vastajatest polnud neid kasutanud. Kõige levinumad toidulisandi tüübid olid mineraal- ja vitamiinpreparaadid, elektrolüüdid, sooritust parandavad ja liigesetervist ning liikuvust soodustavad preparaadid. Peale teatud toidulisandite kasutamist suurem osa vastajatest oli märganud märgatavat (46.3%) või vähest (39.8%) paranemist oma hobuses. Levinuks osutus ka rohkema kui ühe preparaadi kasutamine korraga, ja preparaadi doseering otsustati valmistaja juhendi alusel. Kõige levinum põhjus toidulisandite kasutamiseks oli toiteainete tarbe täitmine.</p>			
Märksõnad: hobune, toiteainete tarbed, söötmine, loomahooldamine, uurima			

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INTRODUCTION

Nutritional supplements are used commonly in horses and the reasons for their use vary all the way from the prevention of dietary deficiencies to the treatment and management of diseases. The market for equine supplements has become more and more extensive, while the legislation concerning their regulation and testing is quite scant in comparison – not to mention that the scientific evidence supporting their use is often limited (Geor, 2006; Murray et al., 2018). As the most owners regard the advice from a veterinarian highly when it comes to the selection of supplements (Murray et al., 2018), the veterinarians should strive to help the owners in making an informed decision when selecting a supplement.

Studies investigating the use of supplements in horses have previously been conducted in Ireland and the United Kingdom, which have noted that the majority of horse owners use supplements in their horses (Agar et al., 2016; Murray et al., 2018). In Finland the use of nutritional supplements in horses specifically has not been investigated before this study.

This descriptive study aimed to characterize the use of nutritional supplements in horses and to identify the main types of supplements used by Finnish equestrians. The aim was to assess the prevalence of supplement use in Finland, along with the reasons, perceptions and practices related to the use of equine supplements.

The study was conducted through an online survey, which was targeted at Finnish horse owners/caregivers who at the moment of answering had the primary responsibility of at least one horse. The data was collected within 4 weeks in February-March in 2019 and it was used to describe and characterize the use of equine nutritional supplements in Finland.

I would like to thank my supervisor professor Toomas Orro for all the help with this work and for always answering my questions. I also want to thank all the people who helped me to promote my questionnaire and those who kindly took some of their time to complete the questionnaire.

1. LITERATURE REVIEW

1.1. Definition and Regulation of Nutritional Supplements

Nutritional and health supplements are widely used to ensure a wholesome diet and to promote health and performance. The term “food supplement” is defined in Article 2 of the Directive 2002/46/EC of the European Parliament and of the Council as “foodstuffs the purpose of which is to supplement the normal diet and which are concentrated sources of nutrients or other substances with a nutritional or physiological effect, alone or in combination, marketed in dose form”. The directive also mentions, that food supplements can be in the form of tablets, pills, liquids and powders and are often intended to be taken in small quantities. However, this definition only applies to human consumers and supplements intended for animals fall instead under the legislative definition of “complementary feed”. The term complementary feed is defined according to the Article 3 of the regulation (EC) No 767/2009 of the European Parliament and of the Council as “compound feed which has a high content of certain substances but which, by reason of its composition, is sufficient for a daily ration only if used in combination with other feed”. This definition also includes “mineral feed” containing at least 40% of crude ash.

Regulation (EC) no 767/2009 also specifies that complementary feed should not be claimed to prevent, treat or cure a disease. Declarations of improving nutritional imbalances are allowed, as long as there are no pathological conditions included in the claim. Additionally, manufacturers do not have to present research concerning the efficacy of the product to be allowed to sell them. This differs from the marketing of medicated feeds, which have stricter regulations and conditions concerning the preparation, placing on the market and use of the product.

1.2. Use of Nutritional Supplements in the Equine Industry

In the equine industry the use of nutritional supplements is commonplace nowadays. In the study of Murray et al. (2018) 98% of non-professional and 86% professionals in Ireland used supplements in their horses, while in the United Kingdom the study of Agar et al. (2016) reported that 95% of respondents used one or more supplements in their performance horses. In both studies the prevention of joint disorders and enhancing performance were cited as the most common reasons for using supplements. However, Agar et al. (2016) also noted

that while behavioral problems were perceived as one of the most common problems, it was not as common reason for using supplements. This could imply that the reason for using nutritional supplements in horses is not always reflected in the opinions of the owner/caregiver.

The amount of available nutritional supplements for horses in the market is quite extensive, which can cause difficulties when selecting a supplement for the owner or caregiver. This can lead the owner/caregiver to seek for advice regarding the choice of supplement and most commonly it is sought from veterinarians, literature and feed merchants (Murray et al., 2015; 2018). Of these sources the opinion of veterinarian had the most impact (Murray et al., 2018).

The aim of this literature overview is to evaluate the commonly used components in supplements intended for joint health and mobility, as they are one of the most commonly used supplements in horses (Agar et al., 2016; Murray et al., 2018). Given the widespread use of supplements in horses, the veterinarians should aim to help the horse owners or caregivers to base the selection of supplement on scientific evidence.

1.3. Supplements Intended for Joint Health and Mobility

As mentioned, lameness and joint disorders are one of the most common reasons to feed oral supplements to horses (Agar et al., 2016; Murray et al., 2018). Feeding joint supplements to horses is usually aimed to treating an existing problem or to prevent/postpone the development of one. Osteoarthritis (OA) is the most frequent the reason for lameness, with approximately 60% of lameness being related to OA (McIlwraith et al, 2016). Therefore, most components of joint supplements aim to mitigate the active mechanisms in the development of OA within the synovial joint (McIlwraith et al., 2016).

1.3.1 Glucosamine

Glucosamine (GU) is included in the majority of joint supplements. The support for its use is related mostly to in vitro studies (Fenton et al., 2000; 2002) and for example Orth et al. (2002) reported that GU decreased the production of inflammatory mediators by chondrocytes while increasing the synthesis of proteoglycans. Extrapolating these results to

the use of GU in vivo, GU could potentially antagonize inflammation and further prevent degenerative changes in the cartilage (Orth et al., 2002).

However, to utilize an orally administered substance it has to be first absorbed from the gastrointestinal tract. In horses the studies evaluating oral bioavailability of GU are few, but pharmacokinetic properties of GU were evaluated by Meulyzer et al. (2008) after intravenous and nasogastric administration. They reported that after the administration of GU sulphate or GU hydrochloride (20 mg/kg BW) the oral bioavailability was 9.4% and 6.1% respectively. The concentration in synovial fluid was also significantly higher at 1 and 6 h after treatment with GU sulphate compared to GU hydrochloride. At 12 h after treatment the concentration of GU sulphate was still significantly over the baseline both in plasma and synovial fluid, but not with GU hydrochloride. In summary, higher synovial fluid levels of GU were attained with GU sulphate compared to the GU hydrochloride, but the therapeutic application was not evaluated in this study.

Leatherwood et al. (2016) studied the potential effects of oral GU supplementation in fourteen yearlings with model of artificially induced synovitis. They evaluated changes in the plasma and synovial fluid in two groups with or without GU hydrochloride supplementation (30 mg/kg BW twice daily) and induced on day 84 an intra-articular localized inflammation in one carpal joint, injecting the other carpal joint with saline as contralateral control. The horses receiving the supplement had increased levels of GU both in synovial fluid and plasma compared to the controls, with greater concentration in the synovial fluid throughout the study. After the artificial induction of arthritis, the GU supplemented horses had reduced increase of synovial inflammatory mediators, decreased catabolic rate of cartilage and increased metabolism of cartilage synthesis compared to the contralateral control.

The duration of supplementation also seems to have an influence on the attained GU concentrations. Laverty et al. (2005) reported that after a nasogastric administration of GU hydrochloride (20 mg/kg BW), the level of GU in synovial fluid was 10% of the concentration in serum at the same time point. These results are in contradiction to the prolonged oral administration trial of 98 days in the study of Leatherwood et al. (2016). Therefore, it could be suggested that a longer administration period is needed to achieve higher GU concentrations in the synovial fluid.

The clinical effect of GU supplementation is still debatable and the evaluation of its efficacy is difficult. GU is often combined with chondroitin sulfate (CS) and other agents like methylsulfonylmethane (MSM) in supplements, so studies solely evaluating the clinical effect of GU are limited. Some studies have evaluated the efficacy of these mixed products, for example one placebo-controlled three-month study in older horses noted no significant difference in the kinematic outcomes (the stride length, carpal flexion, fetlock extension or range of motion) with or without GU supplementation (Higler et al., 2013). As a conclusion, they could not support the use of GU/CS/MSM supplement in older horses to improve stiff gait. Other studies evaluating the clinical effect of mixed products have variable results and are often of low quality, with subjective evaluation of lameness and without control or blinding (Pearson and Lindinger, 2010; McIlwraith et al., 2016).

1.3.2. Chondroitin Sulfate

CS is also one of the major components used in joints supplements and its suggested action in the cartilage is to resist inflammatory responses and to prevent matrix degradation (McIlwraith et al., 2016). As mentioned previously, CS is usually combined with GU in joint supplements. Their use alone or together has been evaluated mainly in vitro studies and the general opinion is that GU and CS are most effective when used in combination (Orth et al., 2002; Neil et al., 2005; Dechant et al., 2005).

The oral bioavailability of CS in horses has also been under discussion, because its size range varies from 6 to 50 kDa depending on the specific form (Neil et al., 2005). This variation in size could potentially have an effect on the form of CS that is eventually utilized by the animal, as the absorbed product could rather be disintegrated metabolites than the intact molecules. The study of Du et al. (2004) evaluated this effect in horses and reported that the oral bioavailability of 8.0 kDa CS was 32% compared to the 22% of 16.9 kDa CS. However, the measurements of the study were not based on the biologically active fraction of the CS, but rather on the disaccharide portion. Whether these results can be applied in the future is still debatable.

1.3.3. Hyaluronic Acid

Hyaluronic Acid (HA) via intra-articular and intra-venous administration has been used in the treatment of lameness associated with joint disease for dozens of years. In comparison the oral HA products have been on the market for less time and the available studies of the efficacy and oral bioavailability in horses are more limited.

In normal synovial joints HA is an integral part of the articular cartilage and synovial fluid. HA is involved in promoting fluid viscosity in the synovium and lubricating the articular cartilage and synovial membrane (Bergin et al., 2006).

Wu et al. (2017) studied the effect of mechanical loading and various amounts of HA on engineered cartilage development. They reported that HA under static conditions did not have an effect on the quality of cartilage, which is controversial to previous studies where HA has been noted to induce matrix growth (Jiang et al., 2007; Galeano et al., 2011). The exposure time was however relatively short in the study which could have influenced the results under static conditions, but with the addition of mechanical treatment and HA supplementation the cartilage development was increased. These results imply that HA supplementation resulted in improved matrix production in mechanically loaded engineered cartilage constructs. Thus, the combination of mechanical loading and HA supplementation could potentially also improve the cartilage development in vivo as well.

In horses, there are mainly anecdotal notes concerning the use of oral HA in the treatment of lameness and actual studies are few (McIlwraith et al., 2016). However, one double-blinded controlled study was conducted by Bergin et al. (2006), where they operated 48 yearlings arthroscopically with unilateral or bilateral osteochondritis dissecans of the tarsus. Half of the horses were treated for 30 days postoperatively with 100 mg HA orally and the rest of the horses received oral placebo. After the 30-day supplementation period, the effusion of operated joint was scored in a scale from 0 to 5 (0 = no effusion, 5 = greater than tennis ball size effusion). The mean effusion score for HA-treated group was 0.7 and for the placebo group the mean score was 2.05. Therefore, oral HA treatment was effective in significantly reducing the amount of effusion in the synovial joint following the arthroscopic surgery compared to the placebo control group.

In summary, the use of oral HA supplements seems to produce good results in horses, but the exact action mechanism is still debatable. Especially HA supplement seems to be

effective in reducing synovial effusion, regardless of the location of the lesion (Bergin et al., 2006).

1.3.4. Green-lipped Mussel (*Perna Canaliculus*)

Historically, the first oral joint supplements available for horses contained glycosaminoglycan complex and other nutrients derived from the Green-lipped mussel (*Perna canaliculus*) (McIlwraith et al., 2016). Since then, the products of *Perna canaliculus* have displayed usefulness in the adjunctive treatment of OA related conditions in humans and animals (Brien et al., 2008; McIlwraith et al., 2016; Saltzman et al., 2017).

P. canaliculus originates from New Zealand and it contains a protein called pernin, which is a non-pigmented, aggregating and glycosylated protein (Saltzman et al., 2017). PERNIN is a serine protease inhibitor and also highly concentrated in the hemolymph of the mussel (Saltzman et al., 2017) As it is the only bioactive protein of the *P. canaliculus* extract, it could potentially be responsible for the beneficial effects of the mussel (Saltzman et al., 2017).

Stabilization of the extract enhances the reported anti-inflammatory effects of the mussel and one of the distinctive processed forms are the lyophilized products of *Perna canaliculus* (LPPC) (Brien et al., 2008). LPPC has demonstrated with in vitro studies that it has many anti-inflammatory effects, which include for example the inhibition of the cyclooxygenase-2 pathway and tumor necrosis factor- α (Rainsford and Whitehouse, 1980; Cheras et al., 2008).

The bioavailability of LPPC and other mussel products are unknown in general (Cayzer et al., 2011), but a related study on the efficacy of LPPC supplementation in treatment of lameness has been reported. A double-blinded, randomized and placebo-controlled study was conducted by Cayzer et al. 2011 assessing OA related chronic fetlock lameness in horses. The horses received treatment with either a LPPC (dose of 25 mg/kg/day) or placebo orally for 56 days. Veterinary lameness examination, swelling, pain, heat and passive flexion of the affected joint were used to evaluate the treatment effect. In the LPPC supplemented group of horses, the response to joint flexion was improved with a reduction in joint pain and there was also a significant reduction in the severity of lameness compared to the control horses.

While the results of Cayzer et al. (2011) demonstrated that LPPC supplementation alleviated the severity of lameness significantly in OA related conditions, the previous reviews of the *P. canaliculus* have concluded that there is variability in the results of efficacy (Cobb and Ernst, 2005; Brien et al., 2008). The form of preparations used in studies concerning the *P. canaliculus* extracts also varies, while they are still all collectively termed as green-lipped mussel extracts (Brien et al., 2008; Cayzer et al., 2011). This makes the efficacy of green-lipped mussel supplementation in the treatment of OA related conditions more difficult to evaluate.

1.3.5. Resveratrol

Resveratrol is a polyphenolic compound, which can be found for example in grape skins and many other plants (Watts et al., 2018). Resveratrol protects the plants against fungal infections, but in mammals it works more as an anti-oxidative, anti-inflammatory and antiapoptotic substance (Watts et al., 2018). It is also used as a popular explanation for the so-called French paradox: French people have commonly a diet high in saturated fats, but the incidence of coronary heart disease is not as high as one would expect (Kopp, 1998). One potential explanation for this phenomenon is the consumption of red wine, which contains resveratrol (Kopp, 1998).

As with most oral supplements, the bioavailability of resveratrol also contains a problem. The crucial property is the microencapsulation, which enables the further absorption and bioavailability of resveratrol (Soo et al., 2016). If resveratrol has not been microencapsulated, it is swiftly metabolized before reaching the tissues (Soo et al., 2016). This implies that the manufacturing process is especially important with resveratrol and the bioavailability is likely to differ between different products and manufacturers (Watts et al., 2016). The bioavailability data concerning resveratrol in horses is limited, but few related studies exist concerning the effect on biochemical parameters. Ememe et al. (2015) noted a significant decrease in the serum concentration of the antioxidant marker malondialdehyde and the glutathione peroxidase activity in horses supplemented for 4 weeks with a product containing both resveratrol and HA (Equithrive Joint®). The other study of Ememe et al. (2016) also evaluated the same product in aged lame horses by measuring the values of creatinine kinase (CK) and glucose, noting significant reduction in both parameters with resveratrol supplementation. As elevation in the CK levels in blood are indicative of muscle

damage (Piccione et al., 2008) and hyperglycemia is often related to ageing process (Broughton and Taylor, 1991), Ememe et al. (2016) suggested that resveratrol supplementation could be beneficial in reducing muscle damage due to oxidative stress and in improving metabolic efficiency in older horses.

The potential of resveratrol in the prevention or treatment of OA is related to its anti-inflammatory mechanisms. Resveratrol causes suppression of the production and activity of interleukin-1 β , cyclooxygenase-2-regulated pathway downregulation and it also scavenges on reactive oxygen species in vitro (Csaki et al., 2007). It has also been evaluated in a mouse model of OA, where intra-articular injections of resveratrol were found to significantly prevent the destruction of OA cartilage (Li et al., 2015). So, resveratrol has demonstrated chondroprotective effects in both in vitro and laboratory animals with induced OA.

Watts et al. (2016) investigated the potential effect of resveratrol in naturally occurring lameness of distal tarsal joints in performance horses, in a place-controlled, randomized and blinded clinical trial. The study included 45 client-owned horses, which all were subjectively and objectively evaluated for lameness via observation of movement, rider opinion and kinematic analysis. After the initial evaluation all horses were injected with a corticosteroid solution (triamcinolone acetonide, 4.5 mg in each joint) to the centrodistal and tarsometatarsal joints of both hindlimbs. Horses were then placed either on a placebo or resveratrol (1000 mg of microencapsulated resveratrol) supplement, which was fed twice daily for 4 months. Rider opinion was determined after 2 and 4 months of supplementation and the reports of improved performance were significantly higher in resveratrol group compared to the placebo group (after 2 months 95% vs 70% and after 4 months 86% vs 50% respectively). The objective lameness evaluation was repeated after 4 months of supplementation and the group receiving resveratrol was significantly less lame on the objective criteria compared to the horses receiving placebo. The objective measure used was the kinematic data: for all collected strides the degree of asymmetry in pelvis movement and for each stride the vertical pelvis movement versus expected movement of the pelvis. All in all, the results supported the potential use of oral resveratrol supplementation in horses with lameness.

1.3.6. Methylsulfonylmethane

During exercise, energy is formed through an oxidation reaction for the cellular processes. This process consumes oxygen, most of which forms carbon dioxide and water. However, approximately 1 to 2% of oxygen does not completely reduce, forming reactive oxygen species (ROS) instead; which in turn can cause oxidative damage (Williams, 2016). Antioxidants can prevent oxidative damage in multiple ways, for example by scavenging ROS, inducing repair of damage and promoting activity of other antioxidants (Williams, 2016). Antioxidants are either synthesized within the body or acquired from the diet, and they include enzymes, minerals, vitamins and proteins (Williams, 2016). When the defense by antioxidants becomes inadequate or ROS accumulation occurs, the oxidation can damage the lipids, nucleic acids and proteins causing a phenomenon called “oxidative stress” (Williams, 2016). Antioxidant defenses can be overwhelmed also by severe or strenuous exercise, which leads to the theory that supplementation with antioxidants can help to alleviate oxidative stress induced during exercise (Marañón et al., 2008; Williams 2016; Butawan et al., 2017).

MSM is a sulfur containing and naturally occurring compound, and it is involved in the synthesis of an important intracellular antioxidant called glutathione (Marañón et al., 2008). In mammals, MSM can be utilized by the gut flora and pharmacokinetic studies in rats and humans indicate that MSM is absorbed quickly within the body (Magnuson et al., 2007; Bloomer et al., 2015). The most common excretion form is urine and for example in rats 59% to 79% of MSM is excreted in the urine within a day from the administration (Otsuki et al., 2002; Butawan et al., 2017). The remaining or persisting systemic MSM forms the bioavailable source and it is distributed quite homogeneously in the tissues, with a half-life of about 12h in rats (Magnuson et al., 2007). In humans there is also some evidence, that suggests that the continuous oral supplementation with MSM in healthy adults is accumulated over time (Bloomer et al., 2015).

Because of its anti-inflammatory effects, MSM is often included in anti-arthritis preparations. The anti-inflammatory properties are supported by *in vitro* studies which suggest that it acts by decreasing the expression of cytokines, which in turn has a protective effect on cartilage (Kim et al., 2009; Ahn et al., 2015). Cytokine expression has also been reduced in experimentally induced models of arthritis in mice and rabbits (Hasegawa et al., 2004; Kim et al., 2009). Many human patients suffering OA have also noted improvement

in their symptoms with MSM supplementation, with suggestions of reduced pain, improvement in swelling and stiffness, leading to impression of overall improvement in physical function in subjective measurement (Butawan et al., 2017).

The knowledge of the effect and bioavailability of MSM in horses however, is limited as the majority of studies involves humans or laboratory animals. One equine study was conducted by Marañón et al. (2008), who investigated the potential of MSM and vitamin C supplementation to reduce oxidative stress in horses during jumping competition. The horses in the study were divided to three groups; control without supplementation, MSM supplementation (8 mg/kg daily) and combined supplementation (MSM 8 mg/kg + Vitamin C 5 mg/kg daily) groups. During the 5 weeks of competition, blood samples were collected weekly after exercise for the analysis. They found that a general increase in the plasma carbon monoxide (CO) levels was induced by exercise, but the CO release was reduced in the MSM supplemented groups. The same applied to lipid hydroperoxide levels which were increased after exercise, but less with MSM supplementation. Also, the protective effect against oxidative stress was greater with combined vitamin C supplementation. This could indicate that the MSM and vitamin C can work synergistically within the cells to protect them from oxidative damage. However, the study did not evaluate whether the supplementation had an actual effect on the performance.

All in all, there is some evidence that suggests that MSM supplementation could have a protective effect in horses with exercise induced inflammatory or oxidative injuries (Marañón et al., 2008). However, the exact mechanism, bioavailability and possible clinical effect of MSM are still widely unknown in horses, which makes it more difficult to fully utilize MSM supplementation in improving and maintaining performance in sports horses.

2. AIMS OF THE STUDY

This is a descriptive study concerning the use of nutritional supplements in horses within the Finnish equine industry. The data was gathered through an online survey in Finnish, which was divided into three parts. The first part of the study was targeted towards the respondent's demographic information and the second part of the study aimed to characterize the use of supplements in horses and the aims of their use. The third part of the online survey focused on the user experience and what kind of information sources are most often utilized when seeking information concerning the use of nutritional supplements in horses.

3. MATERIALS AND METHODS

3.1. Questionnaire

The material for this study was collected through an 18-question online-based questionnaire, which was targeted at Finnish equestrians who had the primary responsibility of a horse at the moment of answering. The questionnaire included both multiple choice and open answer questions, of which two questions were not mandatory.

Pre testing of the survey was conducted in a small target population. The feedback from the pilot study was then used to make minor adjustments to the question phrasing, to ensure correct interpretation of the questions. The participants in the study were informed about how the data would be used and collected as a part of the survey introduction. The introduction included in the beginning of the survey can be found in Appendix 1.

The questionnaire was conducted in Finnish and it was advertised through the regional departments of the Equestrian Federation of Finland, equine related associations and the social media. The answers were collected over a period of 4 weeks between February and March in 2019. Overall, the questionnaire was started by 439 respondents and completed by 372 respondents. The question form used in the online questionnaire can be found in Appendix 1.

3.2. Data Handling

The online-based questionnaire used in the study was generated using the QuestionPro-survey software. The data collected online was exported on to an Excel spread sheet after the closing of the questionnaire. Few respondents (n=13) did not meet the inclusion criteria, as they did not have the primary responsibility of any horse at moment of answering. Their responses were excluded from the further analysis.

3.3. Statistical Analysis

Data management was done with MS Excel 2016 (Microsoft, USA) and the descriptive statistics were calculated using the same software.

4. RESULTS

4.1. Demographics

The survey was started by 439 respondents, of which 372 respondents finished the survey. The majority of participants were women (96.4%). The mean age of the participants was 36-years ($SD \pm 12$), while the average amount of equine experience the respondents had was 24 years ($SD \pm 10$). The distribution of the regional states the respondents resided in is summarized in the Table 1. More responses were received from non-professionals (67.8%, $n=265$) than from professionals (13.5%, $n=53$), while 18.7% ($n=73$) of the participants worked with horses part-time. The equestrian disciplines which the participants reported as their primary field of interest are summarized in Table 2. Those who selected the option “other” as their field of interest were asked to specify their answer in writing. Common answers included involvements such as co-ownership, breeding, stable managements and supportive position in the hobby of a family member.

Table 1. The summary of the regional states of residence as reported by the participants. The distribution of the participants between the regions are expressed as percentages. The total amount of responses received was $n=391$.

Regional state administrative agency	n	%
Southern Finland	155	40.0
Southwestern Finland	121	31.0
Western and Inland Finland	69	17.6
Eastern Finland	24	6.1
Northern Finland	8	2.0
Lapland	3	0.8
Åland	0	0.0
Not currently living in Finland	11	2.8

Table 2. The equestrian disciplines which the participants reported as their primary field of interest. The question yielded in total 391 answers and only one option per participant could be selected. If the option “other” was selected, the participant was requested to specify their involvement via free text answer.

Sport discipline	n	%
Dressage	143	36.6
Show jumping	83	21.2
Eventing	21	5.4
Harness racing	63	16.1
Combined driving	4	1.0
Western	2	0.5
Endurance	1	0.3
Gait competitions	6	1.5
Pleasure	50	12.8
Other	18	4.6

The amount of horses the participants cared for was also assessed, with 40.4% (n=158, all answers n=391) caring for one horse while 39.4% (n=154) had 2 to 4 horses under their care. Of the participants 11.8% (n=46) had the responsibility for from 5 to 10 horses and 8.4% (n=33) had over 10 horses under their care. A few participants (n=13) did not have the primary responsibility of any horses and therefore their responses were excluded from further analysis.

4.2. Supplements Used

Majority of the participants reported to have used supplements, with only 0.5% (n=2) respondents who had not used any supplements in their horses. The most commonly used supplements used were the vitamins and minerals which were used by 94.5% of the participants. The other commonly used (81.0%) type of supplement were the electrolytes and performance enhancing supplements. The types of supplements used are summarized in Table 3.

Table 3. The types of supplements the participants have used in their horses. More than one option could be selected by the same respondent. The amount of answers in this question was n=382, while the total amount of option selected was n=1607. The percentages have been calculated based on the total amount of respondents answering the question.

Type of Supplement	n	%
Joints and mobility	256	67.0
Behavior	103	27.0
Gastrointestinal aids	183	48.0
Electrolytes and performance	309	81.0
Respiratory tract	130	34.0
Vitamins and minerals	361	94.5
Hoofs, skin and coat condition	227	59.4
Senior	36	9.4
Haven't used any supplements	2	0.5

The reasons for using supplements in the horse were most commonly fulfilling the dietary requirements (76.0%, n=290) and enhancing performance and recovery (75.1%, n=287). Using supplements in disease prevention was also quite common (53.9%, n=206). The reasons for using supplements are summarized in the Figure 1.

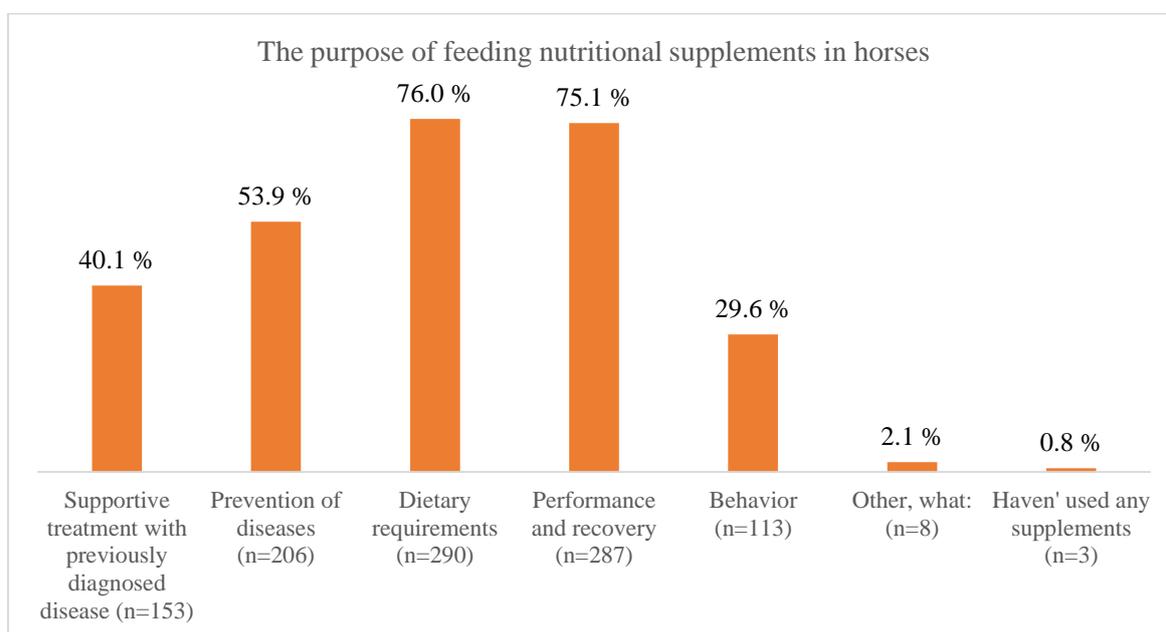


Figure 1. The purpose of using supplements in horses, more than one option could be selected per participant. The amount of answers was n=382, while total amount of options selected was n=1060. The percentages are based on the total amount of respondents answering in this question.

Most of the participants (44.2%, n=169) used two supplements concurrently, while 25.0% (n=94) used three supplements at the same time. More than three supplements were used concurrently by 15.2% (n=58) of respondents, while 15.0% (n=57) used only one supplement at once. The most respondents (72.8%, n=278) used supplements daily, while periodic use was also common (50.0%, n=190). 33.3% (n=127) of the respondents used supplements only when they felt the need for them.

The dosage of supplement used was most commonly based on manufacturer recommendations (89.3%, n=341). The recommendations from the veterinarian were utilized by 39.3% (n=150) of participants, while 33.8% (n=129) of participants determined the dosage based on their own experience. The participants who responded “other, what:”, mentioned that they based the dose on nutritional requirement calculations or on other professional recommendation (seller for example). The responses are summarized in Figure 2.

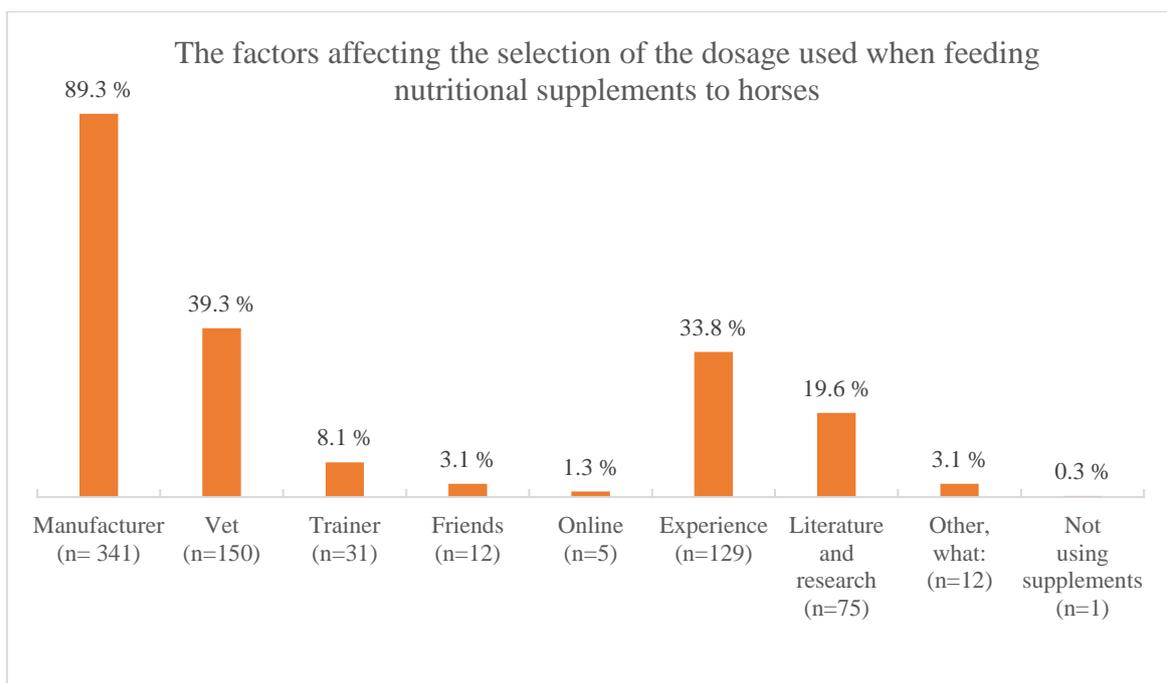


Figure 2. The factors affecting the selection of used dosage when feeding nutritional supplements in horses. The participants were allowed to select more than one option. The question yielded totally n=382 responses, with n=756 options selected altogether. Percentages are calculated based on the total amount of respondents.

After feeding a specific type of supplement, 46.3% (n=177) of the participants noticed a significant improvement in their horse, with 40.0% (n=152) of participants noticed a slight difference. No difference was noted by 7.6% (n=29) of the participants, while 5.2% (n=20) were unsure about the difference. 1.1% (n=4) of participants had not used any supplements in their horses.

4.3. Information Factors

The sources of information utilized by the participants when seeking advice on the use and selection of supplements are presented in the Table 4. The participants that selected the option “other, what” were asked to specify their answer via free text answer. The common other sources of information mentioned were for example previous education of the participant or asking from a family member.

Table 4. The sources of information that the participants used most often when searching for information regarding the use and selection of nutritional supplements in horses. More than one option could be selected by one respondent. The amount of answers received was n=372, while the total amount of options selected was n=1238. Percentages were calculated based on the amount of answers received.

Source of information	n	%
Feed merchant	126	33.9
Related magazines	83	22.3
Literature and research	210	56.5
Veterinarian	224	60.2
More experienced horse person	185	49.7
Other horse owners	144	38.7
Webpages	207	55.7
Online forums	52	14.0
Other, what	7	1.9

Most of the participants were either satisfied or very satisfied (48.9% and 11.2% respectively) with the product label provided by the manufacturer, while some participants were unsatisfied or very unsatisfied (5.7% and 1.6%). The information provided by the seller was regarded mostly very satisfactory and satisfactory (10.2%, 42.7%), while some participants reported to be very unsatisfied or unsatisfied (2.5%, 7.4%). Most participants

(38.1%) felt “neutral” when asked about the availability of consumer accessible research, which was also the most commonly reported answer when inquired about the availability of independent nutritional advice. All of the answers are reported in the Table 5.

Table 5. The opinion of the participants concerning some available information sources. Participants were asked to rate the information source based on their own impression and experience and the question was not mandatory. If the participant had not used supplements before, they were asked to move on to the next question without answering. The

Information source	Very dissatisfied	Not satisfied	Neutral	Satisfied	Very satisfied	Not sure	All answers
Supplement labeling or manufacturer information	1.6 % (n=6)	5.7 % (n=21)	31.7 % (n=116)	48.9 % (n=179)	11.2 % (n=41)	0.8 % (n=3)	366
Seller's information about the product	2.5 % (n=9)	7.4 % (n=27)	34.4 % (n=125)	42.7 % (n=155)	10.2 % (n=37)	2.8 % (n=10)	363
Research available for the consumers concerning the product	4.5 % (n=16)	20.2 % (n=72)	38.1 % (n=136)	24.4 % (n=87)	5.9 % (n=21)	7.0 % (n=25)	357
Availability of independent nutritional advice	3.4 % (n=12)	20.0 % (n=71)	39.4 % (n=140)	21.4 % (n=76)	4.8 % (n=17)	1.0 % (n=39)	355

The recommendation from a veterinarian was reported to have an influence on the selection of supplement by 59.7% (n=222) of participants. Price also had an effect on the selection of supplement in 53.2% (n=198) of respondents. The easy obtainability and recommendation from friends also had some influence on the selection of supplements (40.6% and 39.0% of respondents affected respectively). The participants who also responded with “Other, what” (16.7%, n=62), mentioned influencing factors such as their own experience, moral factors (for example the naturalness, country of production), the amount of active ingredients, research results, good product label with exact amounts of ingredients and the palatability of supplement. The product packaging and the seller’s recommendation did not seem to have that much influence on the selection (11.0% and 13.4% respectively).

5. DISCUSSION

The aim of this study was to investigate the use of nutritional supplements and the rationale behind their use by the Finnish equestrian industry. The results indicate that nutritional supplements are utilized by most of the Finnish horse owners, with only the small minority (0.5%, n=2 of all 382 respondents) having not used any supplements in their horses. This correlates with the results of the previous studies conducted in the United Kingdom and Ireland (Agar et al., 2016; Murray et al., 2018). The mean age of the respondents was 36-years and the average amount of experience with horses was 24 years. The majority of respondents were female (96.4%), with more working with horses non-professionally (67.7%) than professionally.

The type of supplement that was mostly used according to the results of this study were vitamins and minerals, with electrolytes and performance enhancing supplements as a close second. Supplements focused on joint health and mobility were quite commonly used as well, with 67.0% of the participants utilizing them. These results concur with the findings of Murray et al. (2015), who reported salt, joint supplements and fats/oils as the most commonly used supplements. The widely used practice to feed more than one supplement at once and adhering to manufacturer recommendations when determining the dosage has also been reported in previous studies (Agar et al., 2016; Murray et al., 2018). Agar et al. (2016) also reported a similar result with this study, as most owners seemed to regard supplements having an important role in the health and performance of their horse.

The reasons for using certain types of supplements also mostly correlate to previous studies (Agar et al., 2016; Murray et al., 2015, 2018), with the exception that this investigation noted fulfilling dietary requirements as the most common reason for feeding supplements. This differs from the results of Murray et al. (2015), who noted that supplements are often fed to horses without first determining the nutritional needs of the horse. One possible explanation could be attributed to the fact that haylage is most commonly fed to horses in Finland (Jaakkola et al., 2010), while hay and grass are more utilized in the United Kingdom (Hotchkiss et al., 2007). The nutritive and hygienic values in haylage are affected by many factors in the production process (such as time of harvest and fermentation process itself), while production process of hay relies on the dryness of the product and therefore on the prevention of fermentation (Jaakkola et al., 2010). The haylage quality is therefore affected more by the production process than hay, which could reflect to the need to determine the

nutritive needs of the horse based on the deficiencies in the haylage. Another possible explanation to the differences in reasoning could be found in the formation of the question itself: as the question in this survey did not specify whether the respondents actually calculated the dietary requirements of their horses – or just fed supplements based on the assumption of having a possible deficiency in the diet.

When trying to find information concerning the use and selection of supplements, 33.9% of the respondents consulted the feed merchant. This concurs with the previous findings of Agar et al. (2016). Advice from the veterinarian was the most commonly used source of information with the respondents, which has also been demonstrated in other studies (Agar et al., 2016; Murray et al., 2015). Surprisingly 55.7% of the respondents used the different webpages when looking for advice, while few more people (56.5%) included “literature and research” in their answer. The type of information accessed online was not specified in the question however, so there is no differentiation whether information regarding use of specific supplements or basic knowledge regarding equine nutrition was accessed.

Supplement labeling and/or the manufacturer’s information was mostly found satisfactory or very satisfactory by the respondents (48.9% and 11.2%), with 42.7% also satisfied and 10.2% very satisfied with the seller’s information. Most participants were also satisfied with the amount of research available to the consumers or stated “neutral” as their answer. Availability of independent nutritional advice was also mostly referred as “neutral”. The number of participants choosing “neutral” as the answer could be influenced by the previous sources of information the participant had utilized in information search.

The factors influencing supplement selection resembled the results obtained in previous studies (Agar et al., 2016; Murray et al., 2015), as the advice from veterinarian as reported most frequently (59.7% of the participants in this study). Additionally, those 16.7% of the participants who included “Other, what” in their answer were mostly influenced by their own experience and moral factors. The other factors mentioned included good product label with exact amounts of ingredients, which could be related to the fact that the most common reason for feeding supplements in this study was to fulfill the dietary requirements. If the product label is not clear and concise enough, the evaluation and calculation of nutritional needs becomes more difficult and may even require additional education or experience in the matter. If there is an alternative product in the market with a more precise and easy-to-understand product label, it might be selected instead.

The target population in this study included all the horse owners/caregivers in Finland. This indicates that the results discussed above concern the general trends of using nutritional supplements in horses. In the future it could be interesting to focus more closely in certain disciplines, because as noted in the study of Agar et al. (2016), the problems and reasoning between different equestrian disciplines does differ to some extent – which can reflect to the use and choice of supplements. Also, to avoid the misconceptions caused by the phrasing and arrangement of questions, using direct interviewing of a target group instead of an online survey could help us to gain more insights into the use of equine supplements in Finland. This could allow us to further investigate the specific reasoning and the importance of certain factors in the selection processes.

6. CONCLUSION

Nutritional supplements seem to be utilized by most Finnish horse owners, with vitamins and minerals being used most commonly. The reason for using supplements appears to be most commonly based on the nutritional requirements of the horse, which could indicate good awareness of the owner in regards to their horse's nutritional needs. However, this does not overrule the possibility that supplements could be used in excess and thus creating an imbalance in nutrition. This study did not specify how exactly the owners determined the dietary needs of their horses, so evaluating the rationality of the use is difficult. Thus, further investigation into this topic could be beneficial in the future.

As this study focused on the Finnish equestrian population as a whole, in the future smaller target population could be targeted. This could potentially offer us more detailed information how the nutritional supplements are used between different disciplines, as their needs are likely different. Also directly interviewing could offer deeper insights to the types of nutritional supplements used and the rationale behind their use. Additionally, the questions in the survey could be more detailed, by for example including a prioritization or rating of the supplements used.

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APPENDICES

Appendix 1. The introductory text included in the beginning of the online survey, where the participants in the study were informed about how the data would be used and collected.



Kysely lisäravinteiden käytöstä hevosilla

[poistu tutkimuksesta](#)

Hei,

Olen eläinlääketieteen opiskelija Eesti Maaülikoolissa ja teen lopputyötäni hevosten lisäravinteiden käytöstä. Työn tarkoituksena on kerätä tietoa suomalaisten hevosihmisten kokemuksesta, käytöstä sekä mielipiteistä liittyen lisäravinteiden käyttöön hevosilla.

Seuraava kysely koostuu pääosin monivalintakysymyksistä sekä osittain myös vapaista vastauksista. Kyselyyn vastaamiseen kuluu noin 5 minuuttia. Se on suunnattu suomalaisille hevosihmisille, jotka ovat tällä hetkellä pääasiallisessa vastuussa hevosensa hoidosta.

Kysely koostuu kolmesta eri osiosta. Ensimmäisessä osiossa on demografisia kysymyksiä (kuten vastaajan ikä, sukupuoli sekä asuinmaakunta) sekä kysymyksiä vastaajan hevoskokemuksesta. Toinen osio koostuu kysymyksistä liittyen hevosten lisäravinteiden käyttöön sekä niiden käytön tarkoitukseen. Kolmas osio keskittyy niihin tiedonlähteisiin sekä tekijöihin, joita vastaaja useimmiten hyödyntää etsiessään tietoa sekä neuvoja lisäravinteiden käytöstä hevosilla.

Kyselyyn vastataan anonymisti ja vastauksia käytetään ainoastaan tieteelliseen tutkimukseen. Jos sinulla on kysyttävää kyselyyn taikka lopputyöhön liittyen, minuun saa yhteyden sähköpostilla.

Kiitos osallistumisesta,

Terveisin,

Kiia Isotalo

sähköposti: kiia.isotalo@student.emu.ee

[Seuraava](#)

[Tallenna ja jatka myöhemmin](#)

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Appendix 2. The 18-questions included in the online survey. If the question is marked with an asterisk*, it is mandatory. The option “Other, what:” included a free-text answer if chosen.



Kysely lisäravinteiden käytöstä hevosilla

[poistu tutkimuksesta](#)

Kysymykset jotka on merkitty * ovat pakollisia

Osa 1

* Mitä sukupuolta edustat?

- En halua sanoa
- Nainen
- Mies

* Kuinka vanha olet?

(vuotta)

* Kuinka kauan sinulla on hevoskokemusta?

(vuotta)

* Missä maakunnassa asut?

- Ahvenanmaa Etälä-Karjala Etelä-Pohjanmaa Etelä-Savo Kainuu
- Kanta-Häme Keski-Pohjanmaa Keski-Suomi Kymenlaakso Lappi
- Pirkanmaa Pohjanmaa Pohjois-Karjala Pohjois-Pohjanmaa Pohjois-Savo
- Päijät-Häme Satakunta Uusimaa Varsinais-Suomi En asu Suomessa tällä hetkellä

* Mitä hevosurheilun lajia harrastat pääasiassa? Valitse yksi vaihtoehto

- Kouluratsastus Esteratsastus Kenttäratsastus Raviurheilu Valjakkoajo
- Virkistyskäyttö Lännenratsastus Matkaratsastus Askellajiratsastus Muu, mitä:

Jos olet kilpaillut kyseisessä lajissa, millä tasolla kilpailet tai olet kilpaillut?

(Jos ainoastaan hevosesi on kilpaillut kyseisessä lajissa ollessaan sinun hallussasi, voit vastata kysymykseen myös hevosesi tasolla.)

* Työskenteletkö hevosalalla ammatiksesi tällä hetkellä?

- En
- Kyllä
- Kyllä, osa-aikaisesti

* Kuinka monta hevosta tai ponia sinulla on hoidossasi tällä hetkellä yhteensä?

- Ei yhtään
- 1
- 2-4
- 5-10
- yli 10

Osa 2

* Millaisia valmisteita olet käyttänyt lisäravinteena hevosellasi? Valitse yksi tai useampi vaihtoehto

- Kaviot, iho ja karvan laatu
- Seniori
- Ruoansulatusta edistävät
- Elektrolyytit ja suorituksen parantaminen
- En ole käyttänyt lisäravinteita
- Käytöstä muokkaavat
- Vitamiinit sekä kivennäis- ja hivenaineet
- Hengitystiet ja niiden toiminnan tukeminen
- Nivelaineet ja liikkuvuus

* Mihin tarkoitukseen olet käyttänyt kyseisiä lisäravinteita hevosellasi? Valitse yksi tai useampi vaihtoehto

- Aikaisemmin todetun taudin hoito
- Taudin ennaltaehkäisy
- Ruokinnan puutteiden täydentäminen
- Suorituksen edistäminen ja siitä palautuminen
- Hevosen käyttäytymiseen vaikuttaminen
- En ole käyttänyt lisäravinteita
- Muu, mitä:

* Kuinka montaa lisäravinnetta käytät keskimäärin yhdellä hevosella samanaikaisesti?

- 1
- 2
- 3
- yli 3
- En käytä lisäravinteita

* Milloin useimmiten käytät lisäravinteita hevosellasi? Valitse yksi tai useampi vaihtoehto

- Annan lisäravinteita päivittäin
- Käytän niitä kuuriluontoisesti
- Kun huomaan tarvetta
- En käytä lisäravinteita
- Muu, miten:

* Millaisella annostuksella yleensä annat lisäravinteita? Valitse yksi tai useampi vaihtoehto

- Valmistajan ohjeen mukaan
- Eläinlääkärin ohjeen mukaan
- Valmentajan ohjeen mukaan
- Tutun hevosihmisen ohjeen mukaan
- Internetistä löydetyn ohjeen mukaan
- Kokemuksen perusteella
- Kirjallisuuteen tai tutkimustietoon perustuen
- En käytä lisäravinteita
- Muu, miten:

* Oletko huomannut eroa hevosessasi tiettyyn tarkoitukseen suunnattujen lisäravinteiden käytön jälkeen?

- En ole huomannut eroa
- Olen huomannut pienen eron
- Olen huomannut merkittävän eron
- En ole varma
- En ole käyttänyt lisäravinteita

Jos olet huomannut eron hevosessasi tietyn lisäravinteen käytön jälkeen, voit tarkentaa halutessasi enemmän sen vaikutuksesta:

Osa 3

* Mistä yleensä haet tietoa liittyen lisäravinteiden käyttöön hevosilla? Valitse yksi tai useampi vaihtoehto

- Rehumyyjä
- Alan lehdet
- Kirjallisuus ja tutkimustieto
- Eläinlääkäri
- Kokeneempi hevosihminen (esimerkiksi valmentaja)
- Muut hevosihmiset ja tuttavat
- Nettisivustot
- Internetin keskustelupalstat
- Muu, miten:

Otaen huomioon aikaisemmin käyttämäsi hevosten lisäravinteet, kuinka tyytyväinen olit seuraaviin:
(Jos et olet aikaisemmin käyttänyt lisäravinteita hevosellasi, siirry suoraan seuraavaan kysymykseen.)

	Hyvin epätyytyväinen	Epätyytyväinen	Neutraali	Tyytyväinen	Hyvin tyytyväinen	En ole varma
Valmistajan tuoteseloste	<input type="radio"/>					
Rehumyyjän tieto valmisteesta	<input type="radio"/>					
Kuluttajan saatavilla olevat tutkimukset valmisteesta	<input type="radio"/>					
Riippumattoman tahon ruokintaneuvonnan saatavuus	<input type="radio"/>					

* Mitkä seuraavista tekijöistä vaikuttavat päätökseesi ostaa tietty lisäravinne? Valitse yksi tai useampi vaihtoehto

- Hinta
- Eläinlääkärin suositus
- Kokeneemman hevosihmisen suositus
- Valmisteen pakkaus
- Muiden ja tuttavien suositukset
- Muu, mikä:
- Myyjän suositus
- Helppo saatavuus

Vastauksesi on nyt tallennettu.

Kiitos kyselyyn osallistumisesta!

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Hereby I, **Kiia Greta Isotalo**

09/05/94

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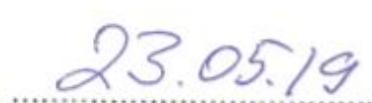


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In Tartu, **23.05.2019**

The core supervisor's approval for the final thesis to be allowed for defence

This is to confirm that the final thesis is allowed for defence.



Supervisor's name and signature

Date