Clinical Nutrition Counselling Service in the Veterinary Hospital: Retrospective Analysis of the Equine Patients and Nutritional Considerations

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32 **Summary**

33 Nutrition has a very important role for both the healthy and ill horse. Though research in this field
34 shows that incorrect nutritional practices may lead to severe pathologies, the wrong feeding plan
35 often continues to be used. In this context a clinical nutrition counselling service (CNC) could be
36 useful to assist the owner and the treating veterinarian. The aim of the present study is to provide
37 information on equine patients referred to the CNC service and to give standard dietary protocols
38 used at our Veterinary Teaching Hospital for the most common nutrition-related pathologies. The
39 data were obtained with a retrospective analysis by collecting the nutritional records of the patients.
40 Information about anamnesis, nutritional assessment, current diet, referring person and follow-up
41 were collected. 61 horses were included in the study. The majority were adult males. The most
42 common breeds were Italian Saddle Horse and Friesian Horse. Old horses had a statistically lower
43 BCS than adults and broodmares ($p<0,01$). The most common nutritional pathologies were chronic
44 weight loss (CWL), chronic diarrhoea (CD) and equine gastric ulcer syndrome. All horses received
45 first cut meadow hay, 85% also ate concentrates. Young horses received more hay as a percentage
46 of body weight (BW) than old horses or adults. Hay percentage of BW per day for CWL resulted
47 statistically higher in comparison to CD ($p<0.01$). Concentrate percentage of BW for old horses
48 resulted statistically lower in comparison to young horses ($p<0.05$). Concentrate percentage of BW
49 per day for colic resulted statistically higher in comparison to CD ($p<0.05$). 28% of cases were

referred by the owner himself and 72% by a referring veterinarian. The follow-up was judged to be "good" in 92% cases and "poor" in 8%. The CNC service could become an epidemiological observatory to study the prevalence of nutritional issues in the equine population.

Keywords horses, nutrition, chronic diarrhoea, weight loss, EGUS, Body Condition Score

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Introduction

The positive effects obtained with appropriate nutrition in human patients has sparked interest in veterinary clinical nutrition (Geor, 2001). Dietary recommendations have an important role in the care and treatment of certain pathological conditions. In human medicine it was seen that a proper nutritional support during illness contributes in obtaining a better outcome and in reducing complications (Munsterman, 2012).

Nutrition is also a fundamental element for a healthy animal, to guarantee its wellbeing and its athletic performance (Becvarova et al., 2009; Roberts and Murray, 2014).

However, even with the increase in research showing the consequences of erroneous nutritional practice (e.g.: diets too rich in high-starch cereal grains, Richards et al., 2006; long intervals between feedings, Luthersson et al., 2009 b) and the correlated rising incidence of nutrition-related problems (e.g. equine gastric ulcer syndrome (EGUS), equine metabolic syndrome, obesity and

laminitis; Luthersson et al., 2009 b; Frank, 2011; Becvarova and Pleasant, 2012), the wrong feeding regimes continue to be applied (Roberts and Murray, 2014).

This could be due to deep-rooted traditions in feeding practices (Harris, 1999), or to a lack of knowledge of nutrition among horse owners and often among veterinarians, too. A high percentage of veterinarians, although they are considered by the owners to be the primary source of information on nutrition, often do not feel they are sufficiently prepared about this topic (Hoffman et al., 2009; Roberts and Murray, 2014; Becvarova et al., 2015).

In this context the specialized advice provided by a clinical nutrition counselling (CNC) service is greatly needed. In human medicine, nutritional counselling practices are considered fundamental to preventing and managing chronic diseases in both adults and children (Ilmonen et al., 2012). In veterinary medicine a CNC service can assist the owners and the practitioners in designing proper diets for the animals according to their requirements and underlying pathologies; since a lot of data about the patients are collected for the evaluation of nutritional status and feeding practices, CNC database could become a useful instrument to look backward and get a clear outline of the biggest problems linked to the nutritional management of the equine population. In this field, reports on nutrition-related problems in horses are scarce. The majority of the papers available are not entirely focused on nutritional issues, but to the related pathologies. Some papers discuss general management and clinical conditions of a particular horse category, like old horses (Ireland et al., 2011 a; Ireland et al., 2011 b), underweight horses (Metcalfe et al., 2013), obese horses (Giles et al., 2015; Bamford et al., 2015; Vick et al., 2007), EGUS (Murray et al., 1996; Reese and Andrews, 2009; Luthersson et al., 2009 a; Sykes et al., 2015). Furthermore, few reports have been published strictly regarding horse owners' nutritional practices (Hoffman et al., 2009; Roberts and Murray, 2013; Roberts and Murray, 2014; Valle et al., 2009).

The aim of the present study is to provide information on equine patients referred to CNC service and to determine their characteristics (age, breed, sex, BCS) and their nutritional assessment. In particular, we performed a retrospective analysis of anamnestic data, diet and follow-up of the patients to investigate what the most frequent reasons for requiring nutritional counselling were. For the most common nutrition-related pathologies, we also provide the standard dietary protocols used at our Veterinary Teaching Hospital.

Materials and methods

The retrospective analysis involved all the horses and ponies referred to the Nutrition Consultancy Service of the Veterinary Hospital of the University of Turin (Italy) during a six-month period (between July 2014 and January 2015). The data were obtained from the nutritional records of the patients, which were recorded during the first nutritional examination, and also by the subsequent updates from the owners or the referring veterinarians.

Anamnestic Information

A complete clinical history was achieved for each animal. A signalment with breed, gender, reproductive status, level of exercise, and age was obtained for each individual. The horses were classified in four age categories basing on their life-stage: “young” if they were younger than 2 years old; “old” if they were older than 19 years old, “broodmares” if they were pregnant and/or lactating and “adult” if they did not belong to any of the other categories. Also, information on environment and housing (such as the possibility to access a pasture or dry lot for free movement) was obtained. A complete list of current and past medications or medical conditions, including regular vaccination and deworming programs, was always taken. It was also asked if there had been any behavioural alterations.

Nutrition-Focused data collection

The nutritional assessment was performed by evaluating the body condition score (BCS) using a 9-point scale method (Henneke et al., 1983). Body weight was calculated by measuring the heart girth with a tape and by applying Bergero's formula (1996).

Also registered was the reason for the required nutritional advice (e.g. presence of a nutrition-related pathology or need to balance the diet of a healthy horse).

Information about the diet administered before asking for the nutritional consultancy was obtained by questioning the owners and by direct evaluation of the feeds present in the stable. The diet was evaluated to identify nutritional imbalances that might have been be linked to the health problems of the animals.

In the nutritional record, the meal composition (i.e. the types of feed used and the doses in kg) was reported both for forage and concentrate. From that, the roughage/concentrate (R/C) ratio was calculated. The amount of feed consumed and the capacity to chew the feed were also evaluated. Furthermore the feeding methods and the numbers of meals per day were evaluated.

Referring Person and Follow up

It was taken into consideration if the referring person was the owner or the treating veterinarian. Where possible, information about the patient's follow-up was also collected. As evaluation criteria, we used the degree of compliance of the referring person to the management of the proposed diet (i.e.: following the instructions about type of feeds, dosages and periods of time for the nutritional therapy), the results obtained in reaching the initial target (i.e.: to gain weight for an underweight horse) and the owner's satisfaction. Basing on these considerations, the follow-up was noted as either "good" or "poor".

Statistics

Analyses were performed with graph pad software after checking the normality of the data. Descriptive statistics were performed to calculate the frequency distribution for anamnestic information (breed, sex and age category), nutrition-based data (BCS, nutritional issue, type of feed

used, hay and concentrated quantities expressed as a percentage of BW per day "as fed", being given when referred, and referring person and follow-up.

For each pathological condition and age category, comparison among groups was performed for BCS, percentage of BW per day "as fed" for hay and concentrate using the Kruskal-Wallis test and Dunns' post-hoc comparison test. Values are expressed as median and interquartile range and p was set at <0.05.

Results

Anamnestic Information

61 horses were included in the study. 62.3% were males (52.5% geldings and 9.8% stallions) 37.7% were females. 15% were young horses (<2 years old), 23% were old horses (>19 years), 10% were broodmares and 52% were adult horses with a mean age of 12±4 years.

15 different breeds were registered: Italian Saddle Horse (14.75%), Friesian (13.11%), German (11.48%), Lusitanian (9.84%), Arabian (8.20%), Standardbred (8.20%), Argentine (6.56%), Pony (6.56%), Dutch (4.92%), Thoroughbred (4.92%), Haflinger (4.92%), Quarter Horse (3.28%), KWPN (1.64), and Irish Cob (1.64%).

Nutrition-Focused data collection

BCS

Median BCS was calculated excluding the horses affected by chronic weight loss, because it could bias the results.

BCS values were calculated excluding chronic weight loss cases. Young horses had a median BCS of 4 (4;5), old horses had 3.3 (2.7;4) broodmares had 6 (4.8;6) and adult horses had 5.5 (4;6). The BCS of old horses resulted statistically lower than adult BCS ($p < 0.01$) and broodmares ($p < 0.01$).

Nutritional issue

The main reasons for which a horse was referred were related to specific medical problems in 67.2% of the cases. 32.8% of the horses were instead referred to balance their diet for growth (13.1%), lactation (8.2%), maintenance (8.2%) and training (3.3%). The medical problems were classified into groups. The first was chronic weight loss (CWL) (19.7%); horses in this category were all adults with either primary teeth problems (16.7%), massive parasite infection (8.3%) or small intestinal malabsorption syndrome (22%). For the other horses with CWL, no specific medical condition was recorded or suspected. The second group is chronic diarrhoea (CD) (13.1%), which include horses without weight loss, but with an idiopathic chronic diarrhoea including production of free faecal water. The other groups were equine gastric ulcer syndrome (EGUS) (13.1%), colic (9.9%, of which 6.6% surgical colic and 3.3% medical colic), or other problems (11.5%, which include 3.3% skin problems, 3.3% equine motor neuron disease, 3.3% kidney failure, 1.6% equine metabolic syndrome).

Type of feed

All horses included in the study received first cut meadow hay. The mean R:C ratio was 78:22. Minimum ratio recorded was 60:40. 15% of horses ate only forage, the others received forage plus concentrate. The concentrates were simple cereals (barley or oat) in 21% of cases and specific feed formulated for horses in 32% (grain mix with a medium protein content of 12% and a medium fibre content of 6%). Other 32% received a homemade mixed feed based on the use of simple cereals plus horse feed.

Hay quantities

Analysing the hay quantities (given as percentage of BW per day “as fed” for each life-stage category) resulted in 1.6 (1.4;1.8) for adults, 1.5 (1.35;1.75) for old horses, 1.55 (1.5;1.8) for broodmares and 2.45 (1.95;2.5) for young horses (Figure 1a). For young horses the percentage of hay BW per day “as fed” resulted statistically significant higher in comparison to old horses ($p<0.01$) and adults ($p<0.01$).

Median hay percentage of BW per day "as fed" for nutritional issue categories was 1.8 (1.8;2.5) for CWL, 1.6 (1.4;1.9) for EGUS, 1.5 (1.35; 1.6) for diarrhoea, 1.5 (1.35;2) for colic and 1.8 (1.55;1.85) for other pathologies. Hay percentage of BW per day "as fed" for CWL resulted statistically higher in comparison to chronic diarrhoea ($p<0.01$) (see figure 2b).

Concentrate quantities

Median concentrate percentage of BW per day "as fed" for life-stage categories was 0.55 (0.31;0.7) for adults, 0.26(0.09;0.62) for old horses, 0.6 (0.38;0.64) for broodmares and 0.65 (0.61;0.73) for young horses. Concentrate percentage of BW for old horses resulted statistically lower in comparison to young horses ($p<0.05$) (figure 1c).

Median percentage of BW per day "as fed" of concentrate for nutritional-issue categories was 0.63 (0.14;0.63) for CWL, 0.65 (0.14;0.82) for EGUS, 0.2 (0.09;0.42) for CD, 0.85 (0.55;1.29) for colic and 0.36 (0;0.52) for other pathologies. Concentrate percentage of BW per day "as fed" for colic resulted statistically higher in comparison to chronic diarrhoea ($p<0.05$) (figure 1d).

Referring Person and Follow up

28% of cases were referred by the owner himself and 72% by a referring veterinarian. The follow-up was judged to be "good" in 92% cases and "poor" in 8%.

Discussion

Results show that the population of horses referred to the Clinical Nutrition Counselling Service was very heterogeneous when it came to age, breed, physiological state, nutritional issues and feeding methods.

The majority of the animals referred to the CNC were adult males and the most common breeds were Italian Saddle Horse and Friesian Horse. According to the database of Italian Saddle Horses, this breed is very common on Italian territory, so this finding is not surprising; the Friesian horse breed is a beautiful breed for showing, used for some local equestrian traditions like Carnival.

Moreover, according to Boerma et al. (2012) some clinical problems seem to have a higher incidence in the Friesian breed and we need more studies to identify if they might even be predisposed to some nutrition-related problems.

According to our results, median BCS resulted significantly lower in old horses compared to adults and broodmares. Aged horses frequently present a low BCS because of dental problems and other age-related medical problems. In our study all the geriatric horses were affected by typical age-related dental problems. As shown in the study by McGowan et al, (2010), this is a typical problem for aged horses and a primary cause of concern for the owner. During a cross- sectional study performed on 200 geriatric horses (≥15 years) in United Kingdom, horse owners were asked to evaluate their horses' BCS, which was a big concern for the owners (Ireland et al., 2012).

However, no differences between the BCS of young horses and other categories were identified. This could be explained because of difficulties in measuring BCS of young horses, since a BCS scale exists only for adults (Henneke et al., 1983).

Old horses were the categories where the BCS was the lowest and their total percentage of BW per day "as fed" of hay or concentrate given by owner was not higher compared to adult or broodmares, with a median quantity of 1.55 for hay and 0.6 for concentrate. Those quantities were even lower than the ones given to young horses. None of the old horses received a specific feed formulated for aged horses, even if increasing difficulty in mastication of forage due to dental abnormalities might have been present. (Geor et al., 2013). According to Ireland at al. (2011) with the aging of horses, even if the owner frequently observes the problems of the old horse, there is a reduced frequency of health care measures. Among them, nutritional advice is one of the most important things, due to the various problems related to ageing, and for this reason, the CNC service could play a pivotal role.

The most frequent medical problems observed were CWL, CD and EGUS. We will not discuss the medical conditions encountered during the clinical practices even if the primary pathology should

246 always be treated by the clinician in an appropriate way. The CNC service could help the clinician
247 to promote healing, or at least improvement of the patient's condition.

248 ***Chronic Weight Loss***

249 In the present study, CWL was present in 19.7% of the cases. These horses started to lose weight in
250 the 6 months before being referred to the CNC. There are many possible causes for BW loss.
251 According to the literature, the most frequent causes are insufficient caloric intake, endoparasitism,
252 dental care problems and nutritional deficiencies (Metcalfe et al., 2013; Crandell, 2005; Stämpfli et
253 al., 2006). Neoplasia, intestinal malabsorption, chronic liver disease could also be observed, but are
254 less frequent (Crandell, 2005). However, for many of the horses in our study, no specific medical
255 condition was recorded or suspected, and in this situation the CNC is essential to try to help the
256 animal. So, given the fact that the medical problem should always be treated, the main goal of the
257 nutritional management of horses with chronic weight loss is to improve the BCS of the animals,
258 adjusting the energy requirement based on the predicted ideal BW and BCS.

259 However, the dietary protocols for the nutritional management of many diseases are not available,
260 and many times they should be based on literature and experience. The predicted BW could be
261 calculated according to the formula proposed by Becvarova and Pleasant (2009) and adapted to
262 BCS increase. In adult horses, each incremental unit of BCS represents 16-20 kg BW (Lawrence,
263 2001). This suggests that for each unit of BCS gained, 20 Mcal/day are required (Lawrence, 2001);
264 however, the energy intake above maintenance energy requirement (MER) should not be over the
265 20-25% of MER (Wambacq et al., 2015; Geor et al., 2013) to avoid problems. This means that to
266 change the BCS of a 500 kg adult horse by one unit, we should give between 3.2-4 Mcal day above
267 maintenance level, over a 90-days period.

268 In this way it is possible to avoid energy excess that could be harmful for the animal and to respect
269 the unique aspects of horse digestive physiology of nutritional components. However even if starch
270 is one the most important energy sources for horses, overload should be avoided due to the limited

capacity of starch digestion of horses. For this reason, it is necessary to limit the starch intake to a maximum of 2g/kg BW per meal (Geor et al., 2013) and a lower limit should be set if other medical problems are present, such as EGUS (as discussed above).

To reach the adequate energy intake without exceeding starch limits, some alternative energy sources can be used, for example fat-rich ingredients. Some of them are vegetable oils like soya, sunflowers or corn; rice bran is also a good energy source (Crandell, 2005). The fat percentage in the diet should not exceed 5-8% of the dry matter (DM) (Zeyner, 2008) to avoid decrease of palatability and maldigestion.

Also a good forage choice is an important step in maintaining the adequate caloric content required. For a horse affected by CWL, the forage should be set at 70-80% of the diet. This means that for a predicted voluntary feed intake of 2% of BW as fed, a 500 kg horse should eat approximately 8 kg of forage.

At the first visit, this category of horse was eating a median quantity of 1.8% of BW per day “as fed” of hay; however, a wide range of this proportion of hay was observed for this category. Of notable importance for this category of horses is not only the quantities given but also the quality of the hay. Good quality first cut meadow hay seems to be the best choice, paying attention to the lignin content. For CWL we usually suggest providing 15-20% of the calculated amount of forage as pelleted hay since it has a more constant composition; these quantities should be increased to at least 50% to 100% for aged horses with dental problems and free access to long hay, if choking is not a risk (Geor et al., 2013).

Pasture time should be also allowed. However, pasture is not always available and in some situations it is better to regulate the daily feed intake. For this reasons we suggest letting horses out to pasture for short periods of time, well distributed throughout the day (2 times a day for ~2 hrs). In this way, it is possible to monitor more closely the caloric intake, appetite and outcome of the feeding plan provided.

Besides the long-stem forage, in many cases alternative fibre sources can be used, if well accepted by the horse. Especially “super fibre” (Harris, 2005), like beet pulps and soya hulls, can be used. It is important to clarify that they should be used in small quantities and not as a substitute for hay, because recently an increased risk of large colonic volvulus in horses fed with beet pulps has been reported (Suthers at al., 2013), and since their composition is totally different from hay. In our CNC service we usually advise beet pulp in a 0.4-0.6 g range per kg of BW.

Finally, it is important to balance the diet with vitamins and minerals according to horses’ requirements (NRC, 2007). If oil is added to the diet, vitamin E requirements are 1 IU/Kg BW plus 1 UI/ml oil (Harris, 2009).

Chronic diarrhoea

CD was present in 13.1% of the horses. Chronic diarrhoea in the horse very often originates from problems related to the large intestine, where the colon has a special function of reabsorbing water from faeces (Stämpfli et al., 2006; Santos et al., 2011; Geor et al., 2013). A dysfunction can be caused by many factors, and among them, the most important could be inflammation due to infections or infiltrative disorders or ingestion of sand, long-lasting use of non-steroidal anti-inflammatory drugs (NSAIDs), and the alteration of the intestinal microbiota and their fermentative activity due to dietary imbalance especially with high-starch diets (Valle et al., 2013).

For the horses included in the study it was not possible to achieve a definitive diagnosis of the primary cause, but they all improved with diet modification. They were the category of animals that received less percentage of hay “as fed” for BW per day compared to the group of CWL, and even less concentrate compared to the colic group. This could be related to the fact that the owner or the referring vet tried making some dietary modification, as anecdotally diarrhoea it often associated with diet. Little information is reported in literature on nutritional management of equine chronic diarrhoea. One of the most important things for horses with chronic diarrhoea is to choose the right type and quality of forage (Valle et al., 2013).

The hindgut is very sensitive to diet type, and cecal and colonic ecosystem could be influenced by both the forage and the concentrate type. High-starch diets could be responsible of dysbiosis in these regions (Kronfeld and Harris, 2003) but forage type could also influence the fermentation characteristics. For example, *Lolium multiflorum Lam. ssp. Italicum,* accumulates fructan as the major storage carbohydrate (de Souza et al., 2005). If this kind of carbohydrate is given in excess, it causes the production of lactic acid and other toxins, and amines in the hindgut (Crawford et al., 2007), increasing inflammation and damage to the mucosa.

For this reasons it is important to give the appropriate forage type, avoiding forages that could be rich in sugars, starch or fructan (Geor et al., 2013). Also, choosing a right proportion of pellet forage could be useful since it helps to reduce the mechanical and physical load on the hindgut (Galvin et al., 2004).

Introducing a pelleted forage in the diet can also help to promote water reabsorption since this also leads to a consistent passage rate of particles and solutes (Van Weyenberg et al., 2006) in the hindgut with a better consistency of the faeces. For this reason, it is essential to avoid greater bulk consumption of long-stem hay since it raises the rate of passage in the hindgut when compared with pelleted diets of smaller particle size (Van Weyenberg et al., 2006).

Adding a pelleted meadow hay where the fibre is grounded rather than chopped can help, since smaller are the particles, lower is the free water fraction, more homogeneous are the digesta and the fibre is retained longer in the colon (Weyenberg et al., 2006; Drogoul et al., 2000). The proportion of pelleted hay to long-stem hay used in our CNC is 40:60; it is important avoid complete pelleted diets, which can be harmful to the normal feeding behaviour of the horse and its natural digestive physiology.

In fact, the lack of foraging opportunity in stabled horses especially, will lead to a reduction in chewing time with a negative impact on the digestive system and behavioural alteration (Ellis et al., 2015).

Feed intake is very important for equine welfare and should be always considered when the diets are formulated. Any diet evaluation for horses based only on the summation of the nutrients, without keeping in consideration other aspects of horse welfare (such as diet presentation and meals division) has many limitations. Interactions among diet composition with modification of apparent energy and nutrient digestibility of concentrate and roughages were already demonstrated in horses (Kienzle et al., 2002), however also diet presentation and other factors could play an important role in the success of the diet plan.

For this reasons they should be kept in consideration and some aids can be helpful in digestive comfort, since they can promote the success of diet plan changes. In particular, for horses with CD, our CNC service advises the use of prebiotics like *Saccharomyces boulardii* that has shown some promise as an adjunctive support for horses with diarrhoea (Boyle et al., 2013).

Equine Gastric Ulcer Syndrome

We observed the presence of EGUS in 13.1% of our cases. In other studies, a very different prevalence can be found, which could be due to the fact that the prevalence of gastric ulceration differs by breed, degree of training, nutritional management, environment and housing, individual horse mood and stress factors in general. (Buchanan and Andrews, 2003; Videla and Andrews, 2009, Sykes et al., 2015).

For example, Luthersson et al. (2009 b) reported that in a population of 201 pleasure horses in Denmark the prevalence of EGUS was 53%. The highest prevalence was found in Thoroughbred racehorses, reaching 80-100% during race training (Murray et al., 1996; Vatistas et al., 1999; Sykes et al., 2015).

On the other hand, Chameroy et al. (2006) registered an EGUS prevalence of 11% (similar to that found in our study) in horses which rarely participated in competitions.

Nutritional management plays an important role in both prevention and therapy of gastric ulcers (Reese and Andrews, 2009). For a horse with EGUS it is important to shorten the intervals between

feeding times to less than six hours (Luthersson et al., 2009 b), by adding more meals during the day and by administering the last daily meal later in the evening. If this schedule is respected, there will be an increase of stomach pH, because saliva and ingesta will flow more frequently, thus buffering the acidic environment (Rees and Andrews, 2009).

To maximize the time spent in feeding activity, it is useful to increase the forage quantity in the diet. Hay should be administered at a minimum dosage of 1-1,5% BW (Videla and Andrews, 2009). In our study, horses with EGUS already received the minimum dosage indicated (the median value recorded was 1.6% BW), but in our CNC even 2% of BW per day "as fed" is recommended, to further increase the feeding time. Since ad libitum forage is not always possible for stabled horses, forage should be put in a net with medium and small holes to increase the time spent on forage ingestion (Glunk et al., 2014).

Also the forage type has to be evaluated: hay should be of good quality and a high straw intake should be avoided, because it can increase the probability of gastric ulceration (Luthersson et al., 2009 b). In addition, it seems that the introduction of alfalfa hay decreases gastric ulcer severity (Lybbert et al., 2007). However, alfalfa is not always as available as traditional hay, so many times we recommend using unmolassed alfalfa chaff: this product is available on the market and could be administered easily to the horse, helping to buffer gastric pH thanks to its contents of calcium and proteins (Nadeau et al., 2000). Moreover, adding chaff to the concentrate meal mix more than doubled the time spent on feed intake (Ellis et al., 2015).

However, cereal-based concentrates in the diet should be reduced, because they contain highly digestible carbohydrates, which are fermented to volatile fatty acids and induce acid injury to the non-glandular squamous mucosa of the stomach (Andrews et al., 2006). The starch intake should therefore not exceed 2 g/kg BW per day and 1 g/kg BW per meal (Sykes et al., 2015), which in a 500 kg horse corresponds to 1 kg/starch per day. In our study, horses with EGUS ate more starch: they in fact received concentrate in an average of 0,65% BW, which in a 500 kg horse corresponds

to 3.2 kg/concentrate per day. Usually, almost a half of the cereal-based concentrate quantity is made up of starch, so these horses were receiving approximately 1.6 kg/starch per day.

If the energy requirements are not satisfied, an alternative energy source could be added to the diet, for example a vegetable oil. In 2004 Cargile and colleagues suggested that a daily supplementation of corn oil at ~10 ml/50 kg BW for 30 days could be useful in prevention and treatment of glandular ulcers, because it had a role in the upregulation of prostaglandin E1, an important factor in the mechanism of protection of the gastric mucosa. Checking the resulting vitamin E levels then becomes necessary for a proper diet.

Fresh water should always be available, even when the horse is at pasture. Notably, water increases stomach pH by diluting gastric fluids (Luthersson et al., 2009 b). In particular, it is important to check the water flow rate if an automatic water dispenser is used, and to also provide a bucket, because often horses prefer to drink from this (Nyman and Dahlborn, 2001).

Finally, several nutraceuticals are available on the market containing pectin-lecithin complexes, alfalfa meal and/or buffering agents. Their efficacy still hasn’t completely been demonstrated (Merritt, 2013), but they can be useful as an adjunct treatment.

To the best of the author’s knowledge, this is the first work which analyses the main nutritional issues referred to a CNC service.

Data revealed that the great majority of the horses were referred by a veterinarian: this confirms that the veterinarian is seen by the owner as a main source of nutritional advice (Roberts and Murray, 2014). The optimum results obtained in follow-up (92% positive) indicate that cooperation between the CNC service and the referring veterinarians is very strong and successful.

Since there is a lack of data about the clinical nutrition of horses, these kinds of studies are useful to share information about nutritional management of prevalent nutrition-related pathologies.

Since the present study was performed on a small sample of subjects (61), collected during a relatively short period (6 months), further investigations are necessary.

To collect more cases, thus extending the CNC database, collaboration with the referring veterinarians is fundamental. Thanks to this mechanism of cooperation, the CNC service could become an interesting epidemiological observatory to study the prevalence of nutritional issues in the equine population.

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585
586 **Figure 1. Percentage of BW of hay and concentrates given to the horses according to their life-**
587 **stage categories (a, c) and to their nutritional problems (b, d).**