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The effect of four different feeding regimes on rabbit behaviour

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ABSTRACT

Dietary composition and presentation impacts on the behaviour of animals, and failure to provide a suitable diet can lead to reduced welfare through the development of poor health, the inability to express normal behaviours and the development of abnormal behaviours. This study assessed the effects of two commonly fed pet rabbit diets (extruded nuggets with hay (EH) and muesli with hay (MH)) alongside hay only (HO) and muesli only (MO) on the behaviour of 32 Dutch rabbits observed over 17 months. Increased time spent feeding was observed in the groups fed ad libitum hay (HO, EH, MH) compared to the MO group ($P < 0.05$). A corresponding high level of inactivity was observed in the MO group compared to rabbits receiving hay ($P < 0.05$). In the groups provided with hay a preference to consume hay in a natural grazing posture was observed. The higher activity levels and absence of abnormal behaviours when hay was fed support recommendations that forage should form a significant portion of the diet for domestic rabbits.

1. Introduction

As herbivores, wild rabbits consume relatively large amounts of a high fibre diet of low nutritional quality (Williams and Wells, 1974). This requires them to apportion a large amount of their time budget to grazing. Rabbits spend 30–70% of time outside the burrow grazing, pausing occasionally to groom (Mykytowycz, 1958; Myers and Poole, 1961; Myers and Mykytowycz, 1958; Lockley, 1961). Time spent eating varies with age, sex and social status within the group and has also been shown to increase when food availability falls during drought (Myers and Mykytowycz, 1958; Mykytowycz, 1958). Grazing occurs mainly during late afternoon and throughout the night and daylight hours are spent underground in warrens (Myers and Mykytowycz, 1958; Mykytowycz, 1958; Lockley, 1961, 1962). Caecotrophy is performed while underground (Southern, 1942). Domestic rabbits kept in free range conditions exhibit a similar feeding pattern to their wild counterparts (Vastrade, 1987; Lehmann, 1991). In contrast, many pet rabbits are housed in small hutches with limited exercise opportunities (Mullan and Main, 2006; PDSA, 2011) and a diet consisting largely of concentrates (mono-component nugget or muesli mixes) (PDSA, 2011) which can be consumed rapidly (Lidfors, 1997), with limited or no access to hay or grass (Mullan and Main, 2006; PDSA, 2011).

Stereotypic behaviours are described as behaviours that are relatively invariant, regularly repeated and without an obvious function (Mason, 1991). Stereotypic behaviours reported to occur in laboratory rabbits include excessive grooming, sham chewing (chewing with nothing in mouth), bar biting, licking parts of cage, digging against cage, biting water nipple, sliding nose against bars, head pressing and running repeatedly in a defined pattern (Gunn and Morton, 1995; Lidfors, 1997). An apathetic state of inactivity and boredom has also been reported by Gunn and Morton (1995). Stereotypic behaviours occur most frequently during the night (Gunn and Morton, 1995) when rabbits are naturally at their most active (Mykytowycz, 1958).

Whilst not studied in pet rabbits, the beneficial impact of providing hay to laboratory rabbits has been demonstrated (Lidfors, 1997; Berthelsen and Hansen, 1999). The provision of hay to individually housed laboratory rabbits has proved effective at reducing the expression of abnormal behaviours (Lidfors, 1997; Berthelsen and Hansen, 1999).

Rabbits can consume pelleted feeds rapidly (Lidfors, 1997) and, whilst they may provide adequate nutrition for the maintenance of the rabbit, foraging behaviour is limited. If fed in limited amounts the rapid consumption of the daily ration may leave the rabbit in a state of hunger for a considerable portion of the day (Lidfors, 1997). It has been suggested that stereotypies in pigs and broiler

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breeder chickens develop through hunger and frustration at an inability to forage (Lawrence and Terlouw, 1993; de Jong et al., 2003, 2005) when a restricted diet is fed. Rabbits provided with hay spend considerably more time interacting with it than with other forms of environmental enrichment, suggesting its importance to this species (Lidfors, 1997).

Despite recommendations that the ideal diet for pet rabbits is one of grasses, herbs, and leaves mimicking that of their wild counterparts (Clauss, 2012), the benefits of hay for meeting behavioural needs of rabbits, and that rabbits are able to maintain weight gain on forage only diets (Lebas, 2004; Leiber et al., 2008), studies suggest that at least 15–17% of pet rabbits do not have access to hay (Mullan and Main, 2006; Schepers et al., 2009) and 36–42% are not fed recommended amounts (PDSA, 2011, 2012). Veterinary surgeons frequently recommend feeding rabbits concentrates in limited amounts, as it is recognised that owners may often feed what may be considered excessive amounts of concentrate diets (Harcourt-Brown, 2002; Meredith, 2006; PDSA, 2011) but it is unclear as to whether ad libitum (*ad lib*) access to hay is routinely recommended.

This study aimed to assess the effect of two commonly fed/recommended diet regimes (extruded nugget with *ad lib* hay and a mixed muesli type diet with *ad lib* hay), alongside a forage based diet and a muesli only diet, on the feeding behaviour and time budget of pet rabbits.

2. Materials and methods

2.1. Study animals

This study was conducted as part of a long term study to assess the effect of diet on the health and welfare of pet rabbits, as previously described by Prebble and Meredith (2014). Thirty two Dutch rabbits from five mixed litters (20 males and 12 females) were purchased at 8–9 weeks old from a single breeder. They were weighed on arrival (mean weight 0.84 kg ± 0.084). The rabbits were housed in 12 male–female neutered pairs and four male–male neutered pairs in wooden floor pens (0.96 m^2) with 12-mm thick rubber matting, with shavings provided as bedding. The pens were split between two rooms with a 12-h light-(06:00–18:00):12-h dark cycle, a temperature of 18 °C (±2 °C) and relative humidity between 40% and 70%. Rabbits were randomly allocated in pairs to four diet treatment groups and day 0 was designated as the day when the rabbits had been transitioned completely onto the treatment diet after an acclimatisation period. Detailed consideration of the experimental setup of the study with regard to the design and housing was undertaken and approved by the Ethical Review Committees of the Royal (Dick) School of Veterinary Studies and the Food and Environment Research Agency (FERA). The rabbits were housed in a facility licensed by the Home Office, however a project licence under the Animals (Scientific Procedures) Act 1986 (ASPA) was not required for this study. The study was continually monitored by the FERA Ethics Committee and Home Office inspector throughout its duration.

In the week following arrival six rabbits displayed signs of digestive disease, subsequently diagnosed as an outbreak of coccidiosis and clostridial enterotoxaemia. Supportive treatment was provided. Despite this, three rabbits died, but three recovered over the following 2 weeks. All remaining rabbits then received prophylactic treatment with a two day course of toltrazuril (Baycox 50 mg/ml Oral Suspension for Piglets, Calves and Lambs, Bayer plc, Newbury, Berkshire, UK) at a dose rate of 2.5 mg/kg (Redrobe et al., 2010) on day −43 and −42 and repeated five days later on day −37 and −36 and metronidazole (Flagyl S 200 mg/5 ml Oral Suspension, Winthrop Pharmaceuticals UK Limited, Guildford, Surrey, UK) at a dose rate of 20 mg/kg twice daily for five days. Three 8 week old Dutch rabbits arrived on day −23 to replace those that died.

Table 1
Nutritional composition of diets offered, with values expressed as %DM.

	Timothy hay	Extruded nugget*	Muesli†
Crude protein (%)	9	13	14
Fat (%)	2	3	2.5
Crude fibre (%)	29	19	14
Ash (%)	6.5	5.5	5
NDF‡ (%)	60	38	29
ADF (%)	33	21	20
Calcium (%)	0.3	0.6	0.6
Phosphorus (%)	0.22	0.51	0.4
Ca:P ratio	1.36	1.18	1.5

* Burgess Excel-Adult Rabbit (Burgess Pet Care, Goole, East Yorkshire, UK).
† Russell Rabbit-Complete Muesli (Supreme Petfoods Limited, Ipswich, Suffolk, UK).
‡ Neutral detergent fibre.
Acid detergent fibre

2.2. Diets

On arrival, rabbits were acclimatised over a period of 40 days (days −54 to −14) by maintaining their weaning diet and were fed 50 g per rabbit of an extruded diet (Burgess® Excel-Junior and Dwarf Rabbit; Burgess Pet Care, Thornton Le Dale, North Yorkshire, UK) once a day plus *ad lib* Timothy Hay. Hay was provided in wall mounted hayracks to enable intake to be monitored and to prevent faecal and urinary contamination which may reduce intake of hay. Water was provided *ad lib* in 700 ml bottles. At day −14 the paired rabbits were allocated to one of four diet treatment groups:

1- Hay only (HO)—*ad lib* supply of Timothy Hay ($n = 8$).
2- Extruded diet and Hay (EH)—50 g per rabbit Burgess Excel-Adult Rabbit (Burgess Pet Care, Thornton Le Dale, North Yorkshire, UK) with *ad lib* supply of day ($n = 8$).
3- Muesli and hay (MH)—60 g per rabbit Russell Rabbit Complete Muesli (Supreme Petfoods Limited, Ipswich, Suffolk, UK) with *ad lib* hay ($n = 8$).
4- Muesli only (MO)—*ad lib* supply (125 g per rabbit) of Russell Rabbit Complete Muesli (Supreme Petfoods Limited, Ipswich, Suffolk, UK) ($n = 8$).

Rabbits were gradually transitioned on to their respective new diets over a two week period (day −14 to day 0) to prevent digestive conditions associated with sudden dietary changes (Tzika et al., 2004). From day 0 to the end of the study (day 510; 17 months), rabbits were only fed the diet of that group.

The nutritional compositions of diets are shown in Table 1. The EH and MH diets represent two commonly fed diets fed according to the manufacturer's guidelines. The muesli consisted of 11 components: extrudates (4 types), pellets (2 types), grains (3 types), rolled peas and alfalfa stalks. Quantities of concentrates offered in the EH and MH groups were based on the lower end of the range of the manufacturer's stated guidelines to replicate dietary advice given by veterinary surgeons (Harcourt-Brown, 2002; Meredith, 2006). The inclusion of the HO group was to provide a forage only diet similar to that of wild rabbits. The MO group was included because many commercially available muesli based diets are labelled as complete or 'nutritionally complete', leading owners to feed them alone. Muesli was provided to the MO group in sufficient quantities to ensure an ad libitum supply of food. All concentrates were weighed out and replaced daily to ensure accurate and consistent weights were offered. No measures were taken to prevent selective sorting or feeding of the different components of the muesli.

In the month following transition all rabbits were neutered and vaccinated against myxomatosis (Nobivac Myxo, MSD Animal