

The effect of distiller's and brewer's grains on beef acceptability

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Abstract

By-products from the distillery and brewery industries are used effectively for finishing cattle in Scotland. However there is not much information available on its effect on eating quality. An experiment was conducted in the north of Scotland in which cattle received two different diets during 100 days. The control diet was based on grass silage, rape and barley, while the experimental diet had straw, barley, brewer's grains and distiller's grains. At day 21 after slaughter, samples from the muscles *longissimus dorsi*, *Gluteus medius* and *semimembranosus* were taken for sensory acceptability panels, sensory profiling panels, and Warner-Bratzler Shear Force (WBSF). No statistically significant differences were observed between the treatments for WBSF nor for most of the sensory attributes. However, the control group *longissimus dorsi* ($P<0.05$) scored better for the attributes of acceptability of aftertaste and overall acceptability and the control *Gluteus medius* ($P<0.05$) scored better for the attributes of acceptability of flavour, aftertaste and overall acceptability. Only a few significant differences in profiling attributes were observed. The results showed that even when a high percentage of brewer's grains and distiller's grains was included in the diet of the experimental group, the mean acceptability score of the beef was between moderately and very acceptable.

Introduction

Distiller's grains and brewer's grains are by-product of the alcohol production industry from cereal grains. Distiller's grains are usually identified by the type of grain used in the distillation process as corn, wheat or barley. This product can be commercialized wet, or dried as pellet, in which case the product is called dark grains. Nutritionally, distiller's grains are low in carbohydrates (low starch), moderately high in proteins but with low protein solubility and low in soluble minerals (Gizzi 2001). Brewer's grains are part of brewer's waste, left after the extraction of the malt required for beer production. The nutritional value of brewer's grains are very similar to distiller's grains. However, distiller's grains have a better protein degradability than brewer's grains (Ojowi, McKinnon et al. 1997). Several studies have been conducted to evaluate distiller's grains and brewer's grains for use in diets of growing and fattening cattle. These trials demonstrated that distiller's by-products, used in the diet of growing and finishing cattle, maintained, if not improved, their performance (Gizzi 2001). Studies conducted on meat quality showed no effect on shear force values or on sensory properties when measured on *Longissimus dorsi* of steers feed with unspecific distiller's grains (Roerber, Gill et al. 2005), or brewer's grains and wheat distiller's grains (Shand, McKinnon et al. 1998), even when they were included at a high level in diets (50% dry matter). However, there is no evidence of the effect of barley distiller's grains alone or with distiller's grains on the sensory acceptability of the meat.

Currently food quality is linked more with the concept of acceptability than with just the physical and chemical characteristics of the product. Acceptability depends on the consumer's perception of the product attributes such as eating quality, price and image (Brunso, Bredahl et al. 2005). Within the *eating quality* attributes, tenderness has traditionally been reported as the most important attribute of red meat. However, recent work shows that 'satisfaction with eating quality' is even more closely related to flavour than tenderness in beef (Oliver 2006). Beef flavour can be influenced strongly by cattle diet (Dannenberger 2006). Therefore, diet could also have a strong effect on the acceptability of beef.

Considering that barley distiller's grains and brewer's grains are used effectively for finishing cattle in Scotland without much information on its effect on eating quality acceptability, this research was designed with the aim to investigate the effects of inclusion of high levels of barley distiller's grains and brewer's grains in the diet of finishing cattle on the consumer acceptability of beef.

Material and methods

The experiment was conducted in the north of Scotland where cattle received two different diets during 100 days. The experiment was a 2 X 2 X 2 factorial design looking at the effects of diet and sex with 2 replicate pens for each diet. The cattle were housed with 10 animals (5/6 steers and 4/5 heifers) in each pen. The control diet was based on grass silage (39% dry matter, DM), rape (17% DM) and barley (44% DM), while the experimental diet had barley straw (11%), barley (44% DM), brewer's grains (17% DM) and barley distiller's grains (dark grains, 28% DM). After slaughter, the carcasses were hip suspended, pH/temperature decline was measured and samples from *longissimus dorsi* were taken for sarcomere length analysis and ultimate pH. The carcasses were boned out 48 hrs after slaughter, the joints were vacuum packed and aged for 21 days. After this period, samples from *longissimus dorsi*, *Gluteus medius* and *semimembranosus* muscles were taken for sensory panels, and Warner-Bratzler Shear Force (WBSF). For sensory acceptability panels, the *longissimus dorsi* and *Gluteus medius* were grilled and *semimembranosus* was roasted. The panellists were asked to assess acceptability of appearance, acceptability of aroma, acceptability of flavour, acceptability of the texture in mouth, acceptability of aftertaste and overall acceptability. For sensory profiling the assessors were trained and the descriptors of the profiling were generated by consensus within panellists. The statistical analysis was conducted by Random Effect Model (REML).

Results

The mean of the ultimate pH over all the groups was 5.53 with a standard deviation of 0.03. The mean over all groups for temperature at pH 6 (pH of rigor) was 30.7°C and the mean for the sarcomere length was 2.68µm with a standard deviation of 0.37. These parameters did not differ between the treatments. No statistically significant differences were observed between the treatments for WBSF, which had an overall mean 2.46 kg cm⁻² and standard deviation of 0.29. Likewise, for most of the sensory attributes, there were no statistically significant differences between diets. However, the control group scored better for acceptability of aftertaste and overall acceptability when measured in grilled *longissimus dorsi* (P<0.05) and for acceptability of flavour, aftertaste and overall acceptability when measured in grilled *Gluteus medius* (P<0.05) (Table 1). There were no significant differences in any acceptability attributes between heifers or steers and between pens (results not shown). Only a few significant differences in profiling attributes were found, with steaks from the experimental diet having a stronger lactic aroma (P<0.05) for *longissimus dorsi* and a weaker beef stock aroma (P<0.05) for *Gluteus medius* than the control diet (Table 1).

Table 1. Mean scores for the acceptability panels (1 extremely acceptable to 8 extremely unacceptable) and for sensory profiling descriptors (intensity between 0 to 100) for control and experimental (Exp) diets for muscles *longissimus dorsi*, *semimembranosus* and *Gluteus medius*

Acceptability of	<i>Longissimus dorsi</i> ⁽¹⁾				<i>Semimembranosus</i> ⁽²⁾				<i>Gluteus medius</i> ⁽¹⁾			
	Diet				Diet				Diet			
	Control ⁽³⁾	Exp ⁽⁴⁾	sed	sig	Control	Exp	sed	sig	Control	Exp	sed	sig
Flavour	2.83	3.09	0.170	ns	3.41	3.48	0.149	ns	3.05	3.35	0.139	*
Aftertaste	2.89	3.21	0.125	*	3.40	3.45	0.128	ns	3.14	3.46	0.147	*
Overall	2.83	3.11	0.139	*	3.37	3.38	0.133	ns	3.13	3.45	0.147	*
Profiling												
Descriptors												
Lactic Aroma	5.6	8.3	1.00	*	9.5	9.7	1.07	ns	9.2	10.1	1.08	Ns
Beef Stock												
Aroma	18.9	16.9	1.94	ns	3.0	2.7	0.34	ns	11.3	9.3	1.35	*

ns indicates no statistically significant differences (P>0.05); *P<0.01; sed standard error of the differences;

⁽¹⁾ Cooking method was grilling; ⁽²⁾ Cooking method was roasting; ⁽³⁾ Control diet based on grass silage, barley and rapeseed;

⁽⁴⁾ Experimental diet based on straw barley, barley distiller's grains and brewer's grains.

Discussion

The sarcomere length values, ultimate pH and temperature at pH 6, showed that the carcasses did not have problems with shortening or with dark cutting beef. The absence of statistical differences in shear force values between the diets is in agreement with previous studies (Shand, McKinnon et al. 1998; Roeber, Gill et al. 2005). Although a high percentage of brewer's grains (17% DM) and barley distiller's grains (28%) were

included in the diet of the experimental group, the mean acceptability scores of beef were good, being rated between moderately and very acceptable. The differences found in acceptability scores for grilled *longissimus dorsi* and *Gluteus medius* contrasts with the results reported by Roeber et al. (2005) and Shand et al. (1998). They found that panels were not able to differentiate between the *longissimus dorsi* steaks of control groups and groups fed with distiller's grains or brewer's grains. However, those studies did not analyze the *Gluteus medius* muscle, for which the difference between diets was more evident in this study. Also, (Roeber, Gill et al. 2005) and (Shand, McKinnon et al. 1998) did not include sensory profiling, which, in the current study, showed small but significant differences between diets for two aroma descriptors.

Over one thousand volatile compounds have been identified in cooked red meat, some of which are responsible for the desirable flavour of beef (Mottram 1991) while others may contribute to the noticeable off-flavours at very low concentration (Melton 1990). Some of these compounds can be influenced by dietary constituents (Dannenberger 2006), while others are influenced by ageing. A long ageing period (more than 21 days) can increase the presence of some off-flavours, such as metallic flavours in beef (Yancey, Grobbel et al. 2006). Thus, in this study, it is possible that factors, such as the possible elevated concentration of certain compounds in distiller's grains or brewer's grains (e.g. copper in distiller's grains, (Gizzi 2001)), in combination with the high level of these products included in cattle diets and the extended ageing time of 21 day, could have caused the lower acceptability score in the experimental group. Further research is required on these products, including the identification of the compounds responsible for the flavour differences, to define the precise role of these factors.

Conclusions

Beef from cattle finished with a diet with high inclusion of barley distiller's grains and brewer's grains, were scored as significantly less acceptable than beef finished on a control diet for some attributes. However this beef was still rated highly by sensory panelists, scoring between moderately and very acceptable.

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