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Whole crop cereals
1. Effect of method of harvest and preservation on chemical composition, apparent digestibility and energy value

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Abstract

A total of 133 samples (53 fermented unprocessed, 18 fermented processed, 62 urea-treated processed) of whole crop wheat (WCW) and 16 samples (five fermented unprocessed, six fermented processed, five urea-treated processed) of whole crop barley (WCB) were collected from commercial farms over two consecutive years (2003/2004 and 2004/2005). Disruption of the maize grains to increase starch availability was achieved at the point of harvest by processors fitted to the forage harvesters. All samples were subjected to laboratory analysis whilst 50 of the samples (24 from Year 1, 26 from Year 2; all WCW except four WCB in Year 2) were subjected to *in vivo* digestibility and energy value measurements using mature wether sheep. Urea-treated WCW had higher ($P<0.05$) pH, and dry matter (DM) and crude protein contents and lower concentrations of fermentation products

Abbreviations: aNDFom, neutral detergent fibre assayed with heat tolerant α-amylase and sodium sulphite and expressed exclusive of residual ash; CP, crude protein; DE, digestible energy; DM, dry matter; DOMD, digestible organic matter in the dry matter; F-P, fermented processed; F-U, fermented unprocessed; GE, gross energy; LW, live weight; ME, metabolisable energy; N, nitrogen; NCGD, neutral detergent-cellulase + gamannase digestibility; OM, organic matter; R^2, variance accounted for; RF-P, rumen fluid-pepsin; r.s.d., residual standard deviation; UT-P, urea-treated processed; WCB, whole crop barley; WCC, whole crop cereal; WCW, whole crop wheat; WSC, water-soluble carbohydrates.

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than fermented WCW. Starch was generally lower in fermented, unprocessed WCW and no effect of crop maturity at harvest (as indicated by DM content) on starch concentrations was seen. Urea-treated WCW had higher ($P<0.05$) *in vivo* digestible organic matter contents in the DM (DOMD) in Year 1 although this was not recorded in Year 2. There was a close relationship between the digestibility values of organic matter and gross energy thus aiding the use of DOMD to predict metabolisable energy (ME) content. A wide range of ME values was observed (WCW, 8.7–11.8 MJ/kg DM; WCB 7.9–11.2 MJ/kg DM) with the overall ME/DOMD ratio (ME = 0.0156 DOMD) in line with studies in other forages. There was no evidence that a separate ME/DOMD relationship was needed for WCB which is helpful for practical application. This ratio and other parameters were affected by year of harvest ($P<0.05$) highlighting the influence of environmental and other undefined factors. The variability in the composition and nutritive value of WCW and WCB highlights the need for reliable and accurate evaluation methods to be available to assess the value of these forages before they are included in diets for dairy cows.

Keywords: Whole crop wheat; Forage conservation; Chemical composition; Digestibility; Energy value

1. Introduction

A number of studies have examined the chemical composition and energy value of whole crop cereals (WCC) produced from cereal crops, most commonly wheat, harvested at relatively advanced stages of maturity (Adesogan et al., 1998a,b). However, studies examining the utilisation of these forages by dairy cows have shown that rumen degradability and whole tract digestibility of the starch fraction can be low (Sutton et al., 1997, 1998). Because of this an increasing proportion of WCC have been conserved by anaerobic fermentation by ensiling less mature cereal crops. For crops harvested at a much later stage of maturity processors have been fitted to forage harvesters to chip or crack the grains before ensiling in order to increase starch availability (Jackson et al., 2004).

The nutritive value of WCC varies according to a number of factors including crop maturity at harvest and treatment application (Adesogan et al., 1998a). For WCC forages preserved in the absence of a fermentation process urea has been extensively used as an additive at ensiling and more recently in combination with processing to disrupt the cereal grains at harvest. These changes in the nature of the types of WCC produced mean that few data currently exist which are representative of the chemical composition or nutritive value of these forages for inclusion in dairy cow diets. Also, previous studies showed that prediction of the metabolisable energy (ME) concentration in WCC from laboratory measurements was problematic with high prediction errors (Adesogan et al., 1999) although this may have in part been due to the availability of relatively small populations of samples with limited between sample variability. The purpose of this study was to produce new information on the chemical composition and *in vitro* digestibility of a wide range of WCC produced on farms in the UK and to assess the effect of method of harvest and preservation. A further objective was to measure *in vivo* digestibility and energy value and to examine the relationship between these parameters.