10.1 Introduction

The oat crop provides a range of products which are utilized in animal feed, for human foodstuffs or as industrial raw materials. These products, which may be derived from different parts of the crop and may be taken at various stages of growth, include whole crop silage, straw, grain and grain derivatives.

As with all natural materials there are variations in the composition of these products. These variations arise from differences between production environments, variations in the genotype of the crop and from interactions between environment and genotype. Environmental differences will include variations in climate, the soil and agronomic practices. Genotypic variation includes the differences between winter- and spring-sown crops and the differences between individual genotypes.

There will also be variations in composition arising from differences in harvesting conditions, postharvesting treatments and in the various processes that the crop is subjected to prior to its utilization as feed, food or for other purposes. Further apparent differences in composition may arise through variations in the analytical methods used.

Oat products such as oat silage, whole crop oats and oats used for grazing are discussed in Chapters 8 and 11. The first part of this chapter reviews the composition of oat straw, grain, hulls, groats and bran. Data have been taken from a variety of sources worldwide and sampling and analytical techniques are evaluated where appropriate. In the second part of the chapter, the groat constituents, including protein, lipid, carbohydrate, fibre, minerals, vitamins and other important, but quantitatively minor, components are described together with production and processing factors which may influence their composition.
10.2 COMPOSITION OF OAT CROP DERIVATIVES

Classical feed analysis gives six proximate constituents – water, protein (measured as crude protein), oil (ether extract), ash (inorganic matter), fibre (measured as crude fibre) and nitrogen free extractives (chiefly carbohydrates, measured by difference) (McDonald et al., 1988). Lignin, which is a fibrous constituent found mainly in straw and hull, is sometimes reported separately. Although some of the techniques have been modified and superseded, data from proximate analyses enable overall composition to be evaluated and comparisons to be made.

10.2.1 Straw

Cereal straw is the above-ground part of the cereal crop which remains at harvest after the crop has been threshed. The main components of oat straw are stem, leaf, sheath and the residue of the panicle (Staniforth, 1979). Straw is high in fibre and generally low in digestible nutrients. The value of oat straw in animal nutrition is reviewed in Chapter 11.

Data on the composition of oat straw are summarized in Table 10.1. All three sources indicate that oil and protein are minor straw constituents and that the main constituents of straw are carbohydrate and fibre. However, the relative proportions of the carbohydrate and fibre constituents vary substantially between reports and this is due mainly to differences in the analytical methods used. In the two older reports in Table 10.1 fibre was analysed as crude fibre and the carbohydrate content was calculated by difference. However, crude fibre involves a very rigorous extraction and gives low values in comparison with more modern methods. Direct analysis of carbohydrate as starch plus sugars shows that the content of digestible carbohydrates is very low (Table 10.1; MAFF, 1992). The more modern detergent methods of fibre analysis yield much higher fibre values which are compatible with the low carbohydrate values obtained by direct analysis.

The lignin content of oat straw is substantial (Table 10.1) and the high degree of lignification of the fibre limits the digestibility of straw and its value in animal nutrition. Lignin levels show variation between sources as a result of both analytical and sample differences. Even greater variability has been reported and Theander and Åman (1978) found 23% lignin in Swedish oat straw samples. These workers also found straw cellulose and hemicellulose contents of 30% and 22% respectively, and they reported the presence of fructose, glucose, sucrose and the sugar alcohols, arabinitol and mannitol in oat straw. However, the sum of these low molecular weight carbohydrates was only 1%.

The ash content of straw is relatively high (Table 10.1). Silica represents a major proportion of the ash but other minerals present include potassium.