

# Protein content related to moisture: Implications for South Africa

By Izak Hofmeyr

In South Africa, the protein content of grain, and specifically wheat, is reported on a 12% moisture level. This is different from most other countries, where protein content is reported on a dry matter (DM) basis. This difference has the potential to cause misinterpretation of results in the industry and thus necessitates a common understanding.

It is for this reason that Agbiz Grain and Rhine Ruhr recently presented a workshop to discuss the issue.

The goal of the workshop was threefold:

- It was aimed at clarifying the approach taken in South Africa to report protein content on a moisture level of 12%, compared to the different approaches in export destinations or countries from which we import products.
- It discussed why other countries report protein content on a DM basis.
- It touched on the differences in the results of the analysis of moisture content (moisture %) by individual companies compared to the Southern African Grain Laboratory (SAGL).

## Protein content and analysis

While it may be that the SAGL and individual companies use different approaches to analysing protein and moisture content, a common standard is necessary. There are several analytical methods that may be suitable and approved, but some may apply to the unprocessed commodity while others apply to the milled product. This may result in the reporting of different moisture levels, as moisture is lost in the milling process or in the case of low moisture unprocessed grain, the milled



product can also absorb moisture from the surrounding environment.

Wouter Oosthuizen from Rhine Ruhr presented an overview of the situation, which served as a point of departure for the discussion.

Moisture content, he pointed out, has a huge impact on the calculation and reporting of protein results of grain. This could lead to discrepancies when grain is imported, based on the protein content in the country of origin being reported at a different moisture level than the standard in South Africa. The net result is that grain, when analysed in South Africa, may not yield the expected protein content at which it was bought.

Protein analysis can be expressed at three different moisture levels, namely at an 'as is' moisture content, a DM basis or, as in the case in South Africa, at 12% moisture.

One of the official methods to analyse protein content is called the Kjeldahl method. According to this method, the sample goes through a digestion process and then a distillation phase. The result is expressed as a percentage of nitrogen, which is then converted to a protein percentage.

When analysing two samples, it is therefore possible that they could show the same protein content, but if the moisture content of the two samples is not the same, the results should not be

compared without taking the respective moisture levels into consideration.

### A straightforward calculation

Wouter illustrated how the calculated protein result can differ when two samples with the same protein content but different moisture levels are converted to the same moisture basis – dry basis in this example.

Sample 1 = 11,2% protein and 7,5% moisture; Sample 2 = 11, 2% protein and 10,5% moisture.

The two samples clearly have different moisture contents, making it necessary to have a basis for comparison. The moisture content has to be brought to the same level – in this case, zero moisture – or dry basis.

The following formula can be utilised:  
 $P2 = P1 * (100 - M2) / (100 - M1)$   
 Where P2 = calculated protein content;  
 M2 = moisture at zero percentage; P1 = known protein value (as is); M1 = known moisture level (as is).

Using this formula, the protein content of Sample 1, with a protein content (P1) of 11,2% and a moisture content (M1) of 7,5%, can be calculated as follows:

$$P2 = 11,2 * (100 - 0) / (100 - 7,5)$$

$$P2 = 12,1\% \text{ protein DM}$$

Sample 2 has a P1 of 11,2% and a M1 of 10,5%:

$$P2 = 11,2 * (100 - 0) / (100 - 10,5)$$

$$P2 = 12,51\% \text{ protein DM}$$

This illustrates clearly that moisture content has a huge influence on protein content, and that a universal basis of comparison is critical to be able to compare apples with apples, or in this case grain with grain. This, he pointed out, is exactly where the problem lies, as most other countries express protein content on a DM basis, and not on a 12% moisture basis as South Africa.

To illustrate the difference in protein value when the dry basis results calculated above are reported on a specific moisture basis (12% mb), the following formula can be used:  
 $P2 = P1 * (100 - M2) / (100 - M1)$   
 Where P2 = calculated protein; M2 = new moisture; P1 = known protein (DM); M1 = known moisture (DM).

Sample 1:  
 $P1 = 12,1$ ,  $M1 = 0$   
 $P2 = 12,1 * (100 - 12) / (100 - 0)$   
 $P2 = 10,65$  protein 12% M.

Sample 2:  
 $P1 = 12,51$ ,  $M1 = 0$   
 $P2 = 12,51 * (100 - 12) / (100 - 0)$   
 $P2 = 11,0$  protein 12% M

This is where the discrepancy often starts when grain is imported from a country that calculates protein content at a different moisture basis than South Africa. Although the protein content is stated correctly in terms of their standards, there often is a discrepancy when that grain is off-loaded here and analysed using measuring instruments calibrated for South African standards.

Grain that might have been bought based on a 12% protein content may now only show a protein content of 10,6% when calculated on a 12% moisture basis. This might have a substantial effect on the grain's grade. (To obtain 12% protein at 12% moisture, the grain would need to have 13,7% protein on a DM basis.)

Why does South Africa base its protein content on a 12% moisture basis? There is no clear answer, Wouter said, but it came about during the period of the Control Boards. The nett result, however, is that there may be confusion about the protein content of imported grain when the differences in reporting standards are not taken into account.

### Moisture determination

As moisture content is so important in calculating and reporting protein content, it is critical that a universal standard is used for determining the moisture content as well. There are many methods to determine the moisture content, but the two most used options for wheat are:

- Whole grain, 72-hour oven method at 103°C.
- Whole wheat flour (milled), two-hour oven method at 130°C.

With the 72-hour method there is no moisture loss as the grain is dried as whole kernels. With the two-hour method, however, there is some moisture loss due to the grinding process. Furthermore, moisture loss can be different for different types of mills. A hammer type mill, for example, causes

more moisture loss than a cyclone type mill.

When comparing moisture results, it is important to establish which method has been used to determine the moisture content of a specific sample. If the same method or type of sample (milled vs unmilled) has not been used, it will be difficult to compare the results.

In most grain silos in the country, wholegrain analyser instruments are used to determine the moisture content of the grain and the 72-hour method is used as the reference method to calibrate the wholegrain analysers. Nevertheless, there are circumstances where the two-hour method has to be used, such as when the falling number of wheat has to be determined.

### The necessity to change or not

Is it necessary for South Africa to change to fit in with the rest of the world? Changing the way in which we do things in South Africa would have enormous implications, although it is not impossible. The consensus at the workshop was, however, that converting values to the system used in South Africa is nothing strange or new. We convert pounds to kilograms and bushels to tons all the time. Converting protein content on a DM basis to a moisture basis of 12% is done in a similar manner.

There is no monetary advantage for any party in the value chain in reporting a protein value based on DM as opposed to 12% moisture. It is all about the way in which it is expressed. The only prerequisite is that protein values need to be converted to the South African standard before these values are compared.

Protein values to be compared should always be calculated/reported on the same moisture basis. In addition, moisture content should always be interpreted with the testing method in mind: was it according to the wholegrain, 72-hour method; or the milled grain, two-hour method? [a](#)

Our thanks to the SAGL for their contribution. For more information, phone Rhine Ruhr on 021 843 3445 or contact Wiana Louw of SAGL at email [Wiana.louw@sagl.co.za](mailto:Wiana.louw@sagl.co.za).