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2010-2015 ANNUAL NUTRIENT TREND ANALYSIS FOR US AND ARGENTINA SOYBEAN MEAL IN THE PHILIPPINES

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ABSTRACT

The study was done to describe trends and compare average annual nutrient analyses of US and Argentine soybean meal (SBM) and to discuss possible factors affecting these changes. Results of chemical analyses for the two ingredients from 2010 to 2015 were obtained from a private analytical laboratory in Batangas, Philippines and were subjected to descriptive statistical analysis. Results showed that the average annual nutrient contents of the two feedstuffs were fluctuating and exhibited high variability between and within the feed ingredient. However, generally, the US SBM had better and relatively more stable nutrient profile than Argentine SBM, particularly for protein solubility, urease activity, ash and calcium contents. The identified factors that may have affected changes in nutrient composition include differences in the trait considered for soybean breeding in the two sources, environmental condition in the planting area, and soybean seed processing. High nutrient value (i.e. protein content and quality) was the major trait considered for US SBM while higher yield was the main focus for Argentine SBM. In addition, the planting strategies for soybeans are being implemented in the US as part of adaptation to either severe flooding or drought. The present study indicated that the two ingredients varies considerably in nutrient contents, therefore it is important to use results of actual chemical analyses in feed formulation to optimize animal performance.

Key words: nutrients, protein, soybean meal

INTRODUCTION

Soybean meal is known to be the "gold standard" protein source used in livestock and poultry diets (Dozier and Hess, 2011). The extensive use of SBM is mainly due to its amino acid composition that compliments many cereal grains (Stein *et al.*, 2008). Globally, US is the biggest producer of soybeans (Masuda and Goldsmith, 2009), while Argentina is the biggest SBM exporter (Caceres, 2013). US and Argentine SBM are commonly used as plant protein source in swine and poultry diets in the Philippines.

However, nutrient composition and quality of SBM vary due to a number of factors that include genetics, location, temperature, drought, and processing (Brown, 2006; Stein *et al.*, 2008; Nahashon and Kilonzo-Nthenge, 2013). Knowledge on the ingredient's composition is important in feed formulation not just to meet the nutrient requirement of the animal but also to prevent nutrient excretion to the environment.

In the Philippines, nutrient analyses of these ingredients are commonly done in farms, feedmills and private analytical laboratories before they are accepted for use. At present, no documented trends on nutrient changes of locally analyzed nutrient composition of feed ingredients have been published.

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Therefore, this study was conducted to describe trends and compare average annual local nutrient analyses of US and Argentine SBM from 2010 to 2015 and discuss possible factors that affected these changes.

MATERIALS AND METHODS

Results of chemical analyses of US and Argentine SBM from 2010 to 2015 were obtained from a private analytical laboratory in Batangas, Philippines. Proximate analyses [moisture, CP, crude fiber (CFi), crude fat (CFat)], ash, calcium, phosphorus and protein solubility (0.2% pepsin), urease activity (Caskey and Knapp method) of feed followed the procedures of Association of Official Analytical Chemists (AOAC, 2002). Yearly average and standard deviation for the different nutrients were computed using MS Excel®. Results were presented as line graphs with standard deviations in order to analyze the trend in nutrient content of the two SBM.

RESULTS

Moisture content of US and Argentine SBM were both noticeably low in 2010 compared to the succeeding years (Fig. 1). From 2011 to 2015, moisture content of both types of SBM remained stable, however, US SBM had higher values than Argentine SBM. On the other hand, CP content of the two ingredients, especially the Argentine SBM was fluctuating during the period (Fig. 2). From 2013, the CP content of US SBM was increasing while for Argentine SBM, it was decreasing. Protein solubility (PS) of US SBM was consistently higher than Argentine SBM (Fig. 3). The gap ranged from 3.56 to 5.81% with almost the same level of variability in the analysis within ingredient. Urease activity (UA) of Argentine SBM remained constant while fluctuations were observed for US SBM (Fig. 4). It can be noted that the UA of the US SBM was always higher than Argentine SBM during this period. CFat of Argentine SBM was higher than US SBM (Fig. 5). CFat of Argentine SBM remained stable while US SBM values were erratic and highly variable. CFi content of both ingredients was relatively stable, but the Argentine SBM had wider variations in values.

The observed trend in ash content was similar for both types of SBM (Fig. 6). From 2010 to 2014, ash content of US SBM was consistently higher than Argentine SBM. In 2015, average ash value for US SBM decreased, while ash of Argentine SBM increased, making the analyzed values similar for 2015. On the other hand, analyzed calcium content was similar for both SBM (Fig. 7). However, in the last two (2) years, US SBM had increasing trend while Argentine SBM tremendously decreased resulting to a wider gap in calcium content between the two ingredients. Meanwhile, phosphorus content remained stable and invariable during the period (Fig. 8).

DISCUSSION

There are different factors that can affect changes in nutrient composition of soybean meal. These include genetics, environmental condition, soil management, processing, and others (Brown, 2006; Stein *et al.*, 2008; Nahashon and Kilonzo-Nthenge,

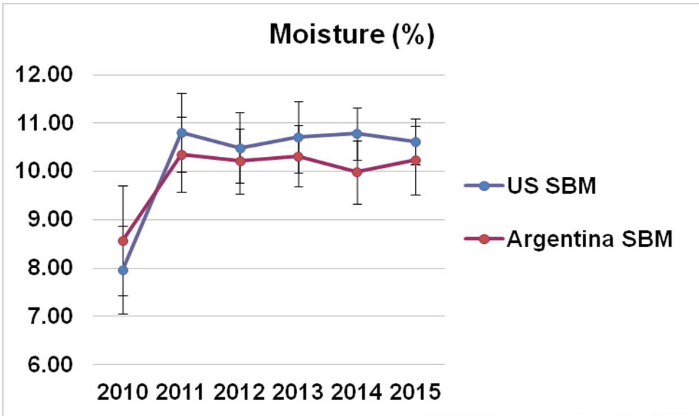

Fig. 1. Moisture content of US and Argentine SBM from 2010-2015.

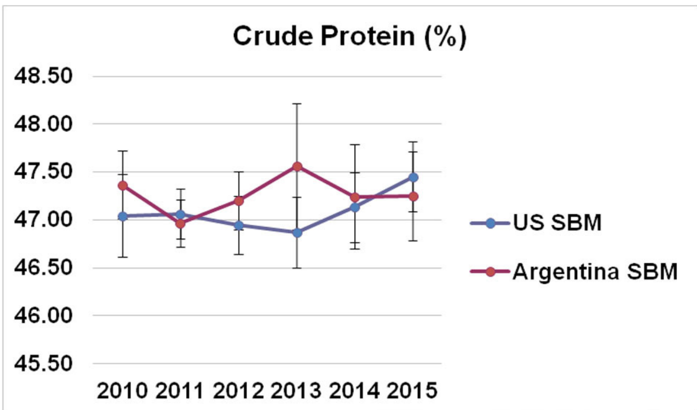

Fig. 2. Crude protein content of US and Argentine SBM from 2010-2015.

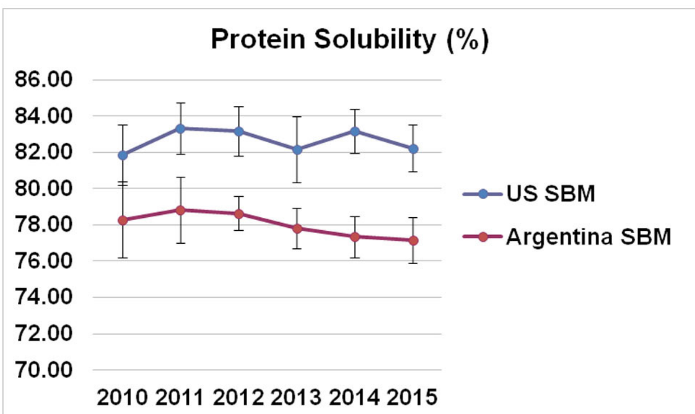

Fig. 3. Protein solubility of US and Argentine SBM from 2010-2015.

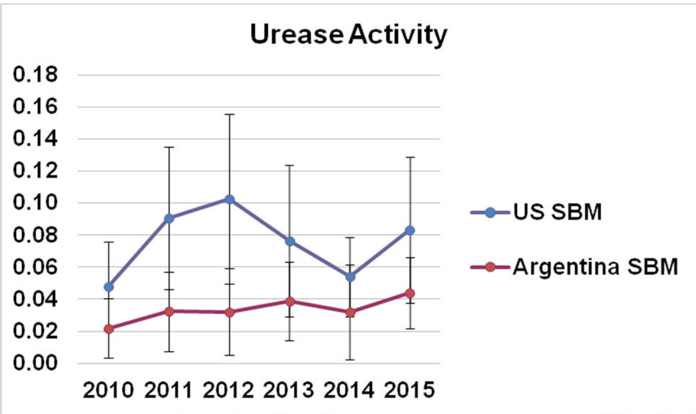

Fig. 4. Urease activity of US and Argentine SBM from 2010-2015.

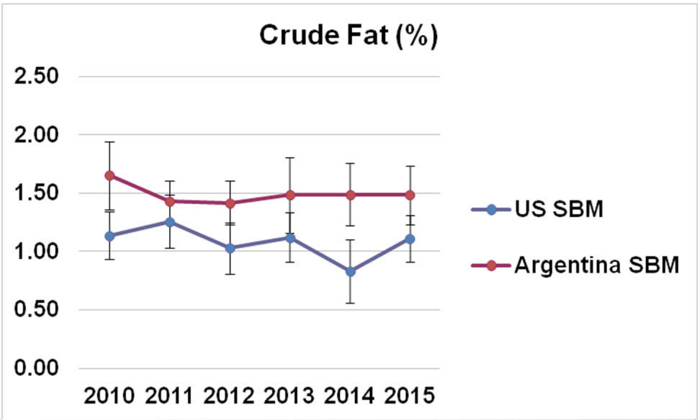

Fig. 5. Crude fat content of US and Argentine SBM from 2010-2015.

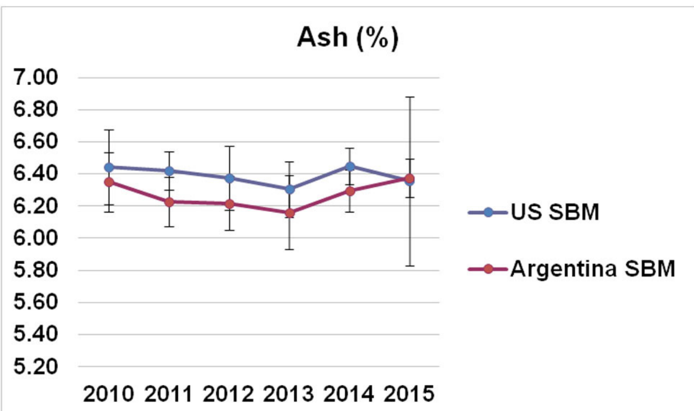

Fig. 6. Ash content of US and Argentine SBM from 2010-2015.

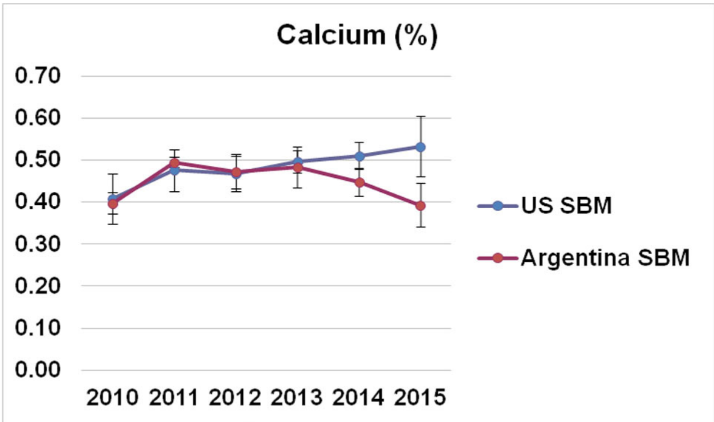

Fig. 7. Calcium content of US and Argentine SBM from 2010-2015.

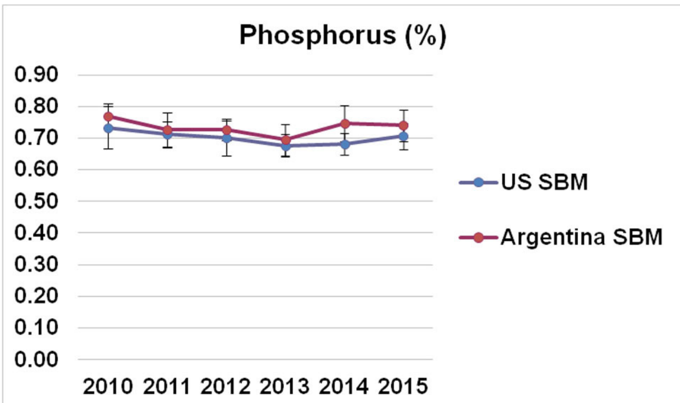

Fig. 8. Phosphorus content of US and Argentine SBM from 2010-2015.

2013). About 99% of soybean produced was genetically modified (Nahashon and Kilonzo-Nthenge, 2013). The first genetically modified soybean was proven to be insect-resistant and herbicide-tolerant, but the nutritional value was unaffected (Stein *et al.*, 2008). In Argentine, genetic modification of this crop focused mainly on yield, resulting to lower protein content (Bronstein, 2013). In most instances, as yield increases, protein content of the seed decreases (Brown, 2006). On the other hand, genetic modifications in US targeted to increase the nutritional value of soybean seeds. These include low trypsin inhibitor activity, low oligosaccharide, low phytate, low fiber and high protein soybean varieties (Edwards *et al.*, 2000; Parsons *et al.*, 2000; Batal and Parsons, 2003; Stein *et al.*, 2008). Our results showed that in 2013, the CP content of US SBM started to increase from 46.9 to 47.5% coupled with increasing protein solubility and urease activity, and a reduction in CFi.

In addition to genetics, environmental stresses such as changes in temperature and rainfall patterns can decrease protein and oil content of soybean seeds (Filho *et al.*, 2004). The present study observed that Argentine SBM had consistently lower CP than the US SBM. Aside from implementing breeding strategies for yield rather than nutrient content, the lack of crop rotation in Argentine's farm belt as well as frequent flood and drought might have contributed to this trend (Bronstein, 2013).

In April to May 2011, the great Mississippi flood occurred in the Midwest US, which resulted not only in decreased soybean production, but also in the reduction in CP content of the seed produced. Protein content of soybean coming from this part of the United States was lower compared to those coming from the rest of America, but as a whole, soybean harvested in the US was similar with 2010 (United Soybean Board, 2013). Drought was already reported even before 2010, and still persists at present (NOAA, 2016). Similar with the results of the present study, CP of SBM in the US generally decreased from 2010 to 2013, then increased in 2014-2015 (USDA, 2015). Advances in US soybean production provided an opportunity to mitigate drought. These include advanced planting of early maturing varieties to avoid most drought-prone period of growing season, developed soybean breeding lines that maintain higher nitrogen fixation rate during drought periods and selection of soybean varieties that are slow-wilting (CAST, 2009). These efforts can be the reason why CP had an increasing trend since 2013.

Processing of SBM also greatly influenced its nutrient content. For instance, screw-pressed have higher oil compared to solvent-extracted soybean, due to lower oil that is harvested from the seed (Woodworth *et al.*, 2001). In processing of SBM, there are times that hulls are added back after solvent extraction and toasting, which resulted to different quantity of protein and fiber (Van Eys *et al.*, 2004). Moreover, US SBM was commonly added with not more than 0.05% ground limestone to improve flowability (Guinn, 2002). Increasing temperature in heat treatment decreased protein solubility of SBM (Parsons *et al*, 1991). Calcium content of SBM may also tend to decrease with increasing heat treatment (Nahashon and Kilonzo-Nthenge, 2013).

The present study described and compared trends in nutrient analyses of US and Argentine SBM. Generally, the US SBM had better and relatively more stable nutrient profile than that of Argentine SBM's, particularly for protein solubility, urease activity, ash and calcium contents. Differences were attributed to a number of factors such as genetics, planting environment and seed processing. Results suggest the importance of using real-time results of nutrient analyses in formulating diets for more efficient animal production.

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