Full fat soybean meal revisited

Modern processing methods together with dehulling have greatly increased the nutritional value of full fat soybean meal and this second generation full fat can now perform significantly better than soybean meal plus vegetable oil in poultry diets, writes NG LIEW EE*.

Traditional methods of processing

1. Dry/Wet Extrusion

The soybean is hammermilled and extruded through an extruder at 120 to 160°C. This is a short time, high pressure and high temperature process. The cooking is through heat and by the dissipation of the mechanical energy resulting in starch gelatinization, protein denaturation, inactivation of enzymes and the destruction of micro-organisms. Dry extrusion capitalizes on the heat generated through friction as the sole source of heat to cook. Wet extrusion requires pre-conditioning of the beans, steam injection and the resulting extrudate may require drying.

2. Roasting

The whole soybeans are subjected to an intense dry heating at 120-150°C. The heat source for this cooking can be generated by an oven, a coal burner or directly by a flame. This is a high temperature long cooking time process. As the control system and the design of the equipment are rather poor, these have caused uneven heating and the resulted cooked soybeans are always overheated or become charred.

3. Micronisation

The whole soybean is cooked continuously by Infra-Red rays emitted by heated ceramic tiles. The infra red rays give up their energy to soybean by exciting the molecule in the bean which vibrates at a frequency of 600-1200 million megacycles per second. This results in rapid internal heating and a rise in water vapor pressure. The bean is cooked from the inside out and it swells and fractures. These changes, coupled with the high temperature (118 – 220C), causes carbohydrates to become more digestible, causes the cells to rupture and the inactivation of anti nutritional factors contained therein (Murray, 1987; Fellows, 1988).

Full fat soybean meal is a product constituted of approximate 82% of soybean meal and 18% of soybean oil. It is use as a protein or amino acids and energy source in animal diets. A properly controlled processing method is essential to release these nutrients efficiently. The above processing methods do not optimize the nutrient quality of full fat soybean meal as they

Figure 1: The AME of full fat soybean meals from various origins.

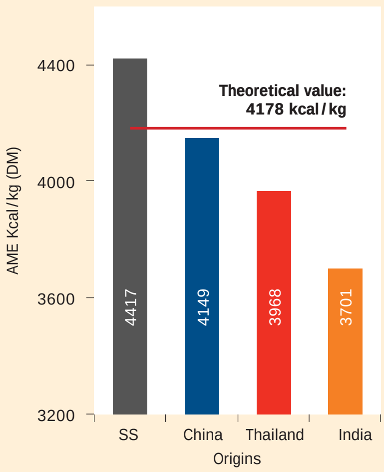


Table 1: Chemical Composition of various type of full fat soybean meals.

Item	HE DFF	Extruded FF	Roasted FF	Micronized FF
Moisture (%)	10–11	10.6	6.0	7.9
Protein (%)	36–38	34.2	35.6	36.5
Total Oil (%)	20–22	19.4	19.1	18.4
Milling fault (%)	0.2–0.4	3.05	7.12	5.03
*Total oil Av, (%)	> 20	16.4	12.0	13.3
C. Fibre (%)	2.5–3.0	6.3	15.6	6.9
PDI (%)	35–50	24.5	10.8	12.8
Delta pH	0.05–0.10	0.23	0.06	0.02
TIA (mg/g)	5–7	11.0	1.9	2.7
KOHPS (%)	85–90	87.9	35.8	88.2

* Total oil av.% is calculated from total oil % minus milling fault %.

use very high temperature in their process. High heat treatment may reduce anti-nutritional factors very efficiently, however it causes reactive amino acids such as lysine and cysteine to bind with reducing sugar to form Maillard reaction complex which make them not available to animals.

4. New processing methods

A new processing technology has been developed by Soon Soon Oilmills, Malaysia; which is focused increasing on the availability of amino acids/protein and energy of full fat soybean meal. The resulting full fat is described as a high efficiency dehulled full fat soybean meal (HE DFF).

Quality comparison

The chemical composition of the full fat soybean meals produced by the above different methods is presented in table 1. It is obvious that the milling fault of the full fat soybean meal produced from the conventional processing methods is much higher than the HE DFF. Milling fault is a test method that can be used to quantify the amount of oil trapped in oil cells that cannot be used by the animals especially the young animals such as piglets and poultry.

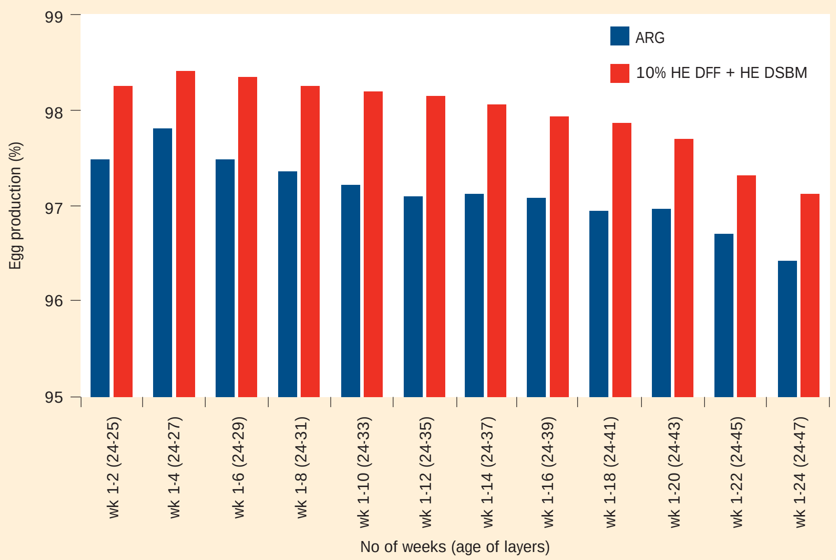
At the present high price of energy, a loss of 1% oil in terms of milling fault in full fat soybean meal will reduce 65.5 Kcal/kg of energy (AME of soybean oil and dehulled soybean meal are assumed to be 9000 kcal/kg and 2450 kcal/kg respectively) which cost USD 10.47 (price of soybean oil and DSBM as at July 2008 is USD 1450/mt and USD 610 respectively).

Crude fiber of the roasted full fat meal appeared to be extremely high due to overheating, most of the beans can be seen as seriously burned after the roasting process. Low readings of KOHPS and PDI results for this full fat shows that the protein or amino acids quality has been damaged.

Apparent metabolizable energy

Full fat soybean meals produced by different countries have been collected and analysed for their AME by ASA. The samples were from Soon Soon Oilmills (SS) Malaysia, China, Thailand and India. The AME

Figure 2: Cumulative egg production rate of layers from age 24 weeks to 47 weeks.



results expressed on dry matter basis are presented in Figure 1. The AME (DM) of SS, China, Thailand and India full fat soybean meal tested to be 4417, 4149, 3968 and 3701 kcal/kg respectively. SS full fat soy not only had the highest AME, but its AME value is also higher than the theoretical value of 4178 kcal/kg. The theoretical value is derived from the assumption that full fat is constituted from 80% dehulled soybean and 20% soybean oil. The AME of dehulled soybean meal is assumed to be 2450kcal/kg and the AME of soybean oil is 9000kcal/kg.

Trials

Broiler starter trial

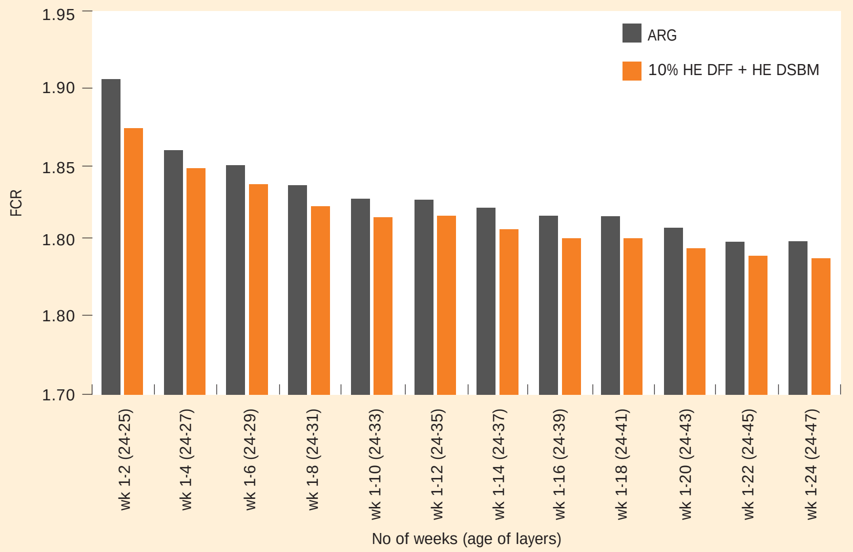
High Efficiency dehulled full fat soybean meal (HE DFF) has been tested in broiler starter diets at 0%, 5% and 10% incorporation rate using iso-caloric and iso-nitrogenous diets. A dehulled soybean meal produced by Soon Soon Oilmills, Malaysia was used in conjunction with the HE DFF in this trial. Dehulled Argentinean soybean meal (ARG SBM) was used as a control. The results showed that as the percentage of HE DFF increased, weight gain of the broiler chicks increased in a linear manner from 749.6g without HE DFF to 766.6g with 10% DFF SBM ($p < 0.05$). The control Argentinean soybean meal diet gave 740.8g of weight gain.

In the case of FCR, the best result (1.366) was obtained at 5% HE DFF incorporation rate compared with 1.381 without HE DFF. Increasing DFF SBM in the diet to 10% resulted in a higher FCR of 1.387. The control diet using ARG SBM gave an FCR of 1.412 which was statistically different ($p<0.05$) when compared to the other test diets. These results

Table 2: The calculated nutrients of the diet using Argentinean soybean meal with palm oil and diet using SS dehulled soybean meal with HE DFF.

Nutrients	Argentine SBM with palm oil	10% HE DFF with HE DSBM
ME, kcal/kg	2750	2680
Crude Protein, %	17.0	16.6
Calcium. %	3.85	4.16
Phosphorus (avail), %	0.42	0.42
Linoleic, %	1.512	2.29
Digest. Lysine, %	0.77	0.751
Digest. Met, %	0.444	0.434
Digest. M+C, %	0.68	0.663
Digest. Threonine, %	0.56	0.546
Digest. Tryptophan	0.175	0.17

Figure 3: Cumulative FCR of layers from age 24 weeks to 47 weeks.



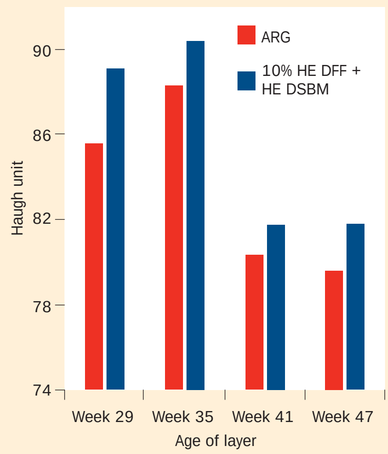
seem to indicate that the optimum level of HE DFF in broiler starter diets is probably between 5 to 10%. All the test diets performed better than the control diet using ARG SBM. (Neoh and Ng, APPC 2007).

Layer trial

A layer trial was designed based on the hypothesis that the nutrients content of the HE DFF when used together with a high efficiency dehulled soybean meal (HE DSBM) will have at least 10% more nutrients than Argentinean dehulled soybean meal in combination with crude palm oil in layer feeds. Two treatment diets were used to test this hypothesis. In the first treatment, a diet was formulated with normal nutrient specifications according to ISA Brown's recommendation using Argentine SBM together with palm oil. In the second treatment, a diet was formulated with 2.5% lower ME and digestible amino acids using HE DSBM together with 10% HE DFF. A 2.5% reduction in nutrients was used based on the assumption that SBM is used at 25% of the diet.

Three hundred eighty four ISA Brown 24 week-old laying birds were used to compare 2 treatment diets. Each diet was assigned 12 replicates of 16 birds. The trial was conducted for a total period of 24 weeks. The egg production rate and feed intake were measured on a weekly basis. Cumulative egg production rate and cumulative feed conversion ratio were then calculated and they are presented in figures 2 and 3. Haugh units of the albumen were measured at the age of 29, 35, 41 and 47 weeks and the results are presented in figure 4. The calculated nutrients content and formulations of the treatment diets are presented in table 2 and table 3 respectively. The results showed that despite receiving a diet with 2.5% lower apparent ME and digestible amino acids, birds on the diet formulated with HE DSBM plus 10% HE DFF outperformed those on a diet formulated with Argentine SBM supplemented with palm oil at normal nutrient levels.

Figure 4: Haugh units of albumen for eggs from layers fed with diet using 10% HE DFF with HE DSBM and layeres fed with diets using Argentinean DSBM plus palm oil.



Conclusions

A new high efficiency dehulled full fat soybean meal has been demonstrated to possess high AME when compared to other full fat soybean meals. Poultry and pig feeding trials have also demonstrated improvements in performance. Interestingly the measured AME is 239kcal/kg higher than the theoretical value.

When used together with a high efficiency soybean meal, it can give improved layer performance even with a 10% nutrient handicap when compared to Argentinean dehulled soybean meal and crude palm oil.

In broiler starter feeds adding 5 to 10% of this full fat to the diet can improve FCR and body weight gain. ■

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Table 3: Diet formulations of treatments using Argentinean soybean meal with palm oil and HE DFF with HE DSBM.

Ingredients	Argentine SBM with palm oil, %	10% HE DFF with HE DSBM, %
Corn	54.72	51.86
Wheat Pollard	6.0	10.0
Argentine HiPro	25.14	0
SSHE Dehulled SBM 46.5	0	15.66
SSHE Full Fat Dehulled SBM	0	10.0
Palm Oil	2.46	0
Limestone	9.2	10.0
MDCP 21	1.45	1.38
Salt	0.21	0.20
Sodium Bicarbonate	0.2	0.20
Vitamin-Mineral Premix	0.25	0.25
Choline Chloride 60	0.08	0.08
L-Lysine HCL	0.02	0.03
DL-Methionine	0.21	0.21
L- Threonine	0.06	0.06