Opportunities For The Use Of Lupins In Asian Foods And Animal Feeds

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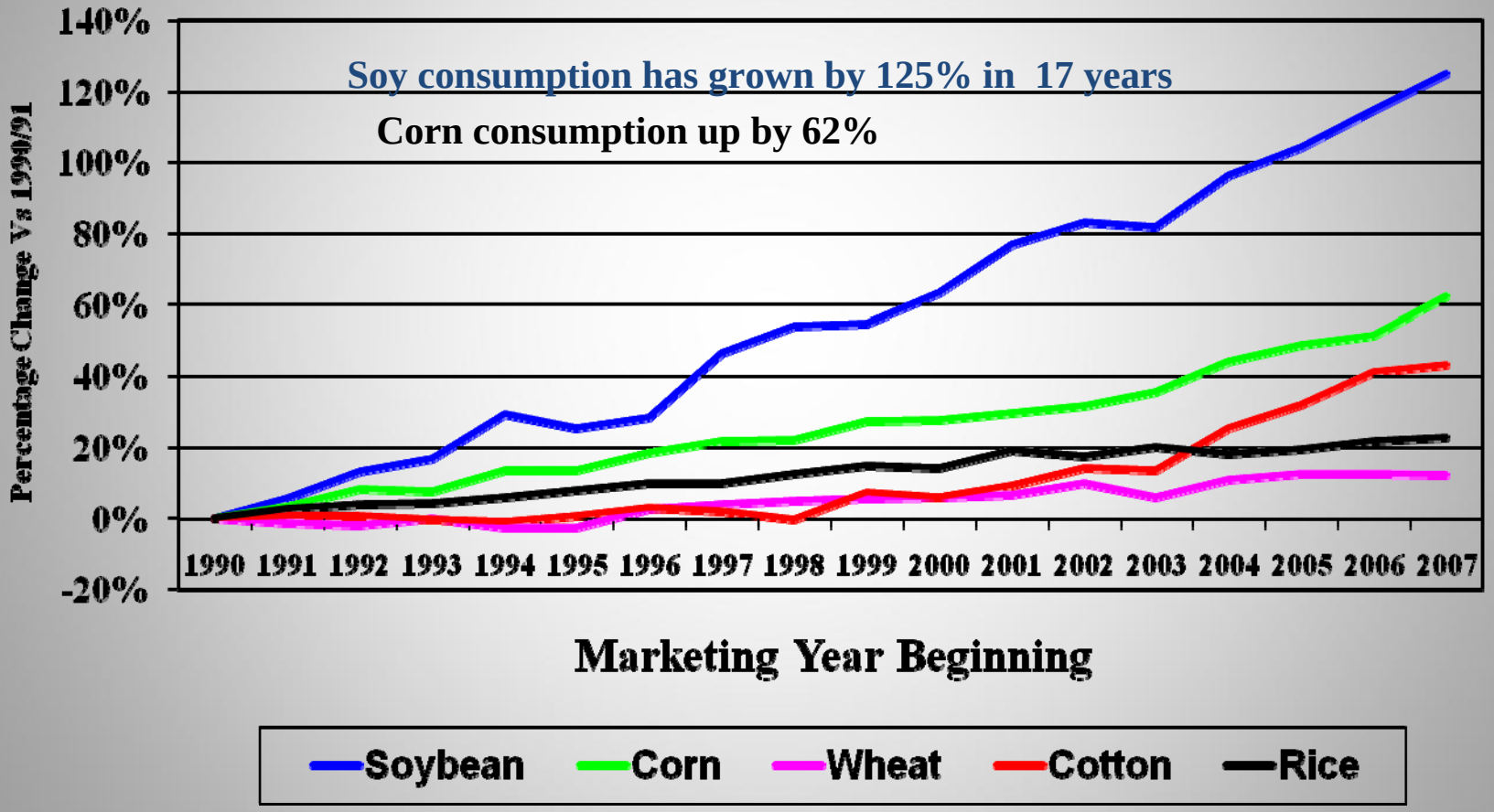
Is There A Market For Lupins In Asia For Food & Feed?

Total Asian Imports and Consumption of Soybeans and Soybean meal for 2007

Soybean import: 45 Million tons
Soybean production: 25 Million tons
Total Soybean usage: 70 Million tons

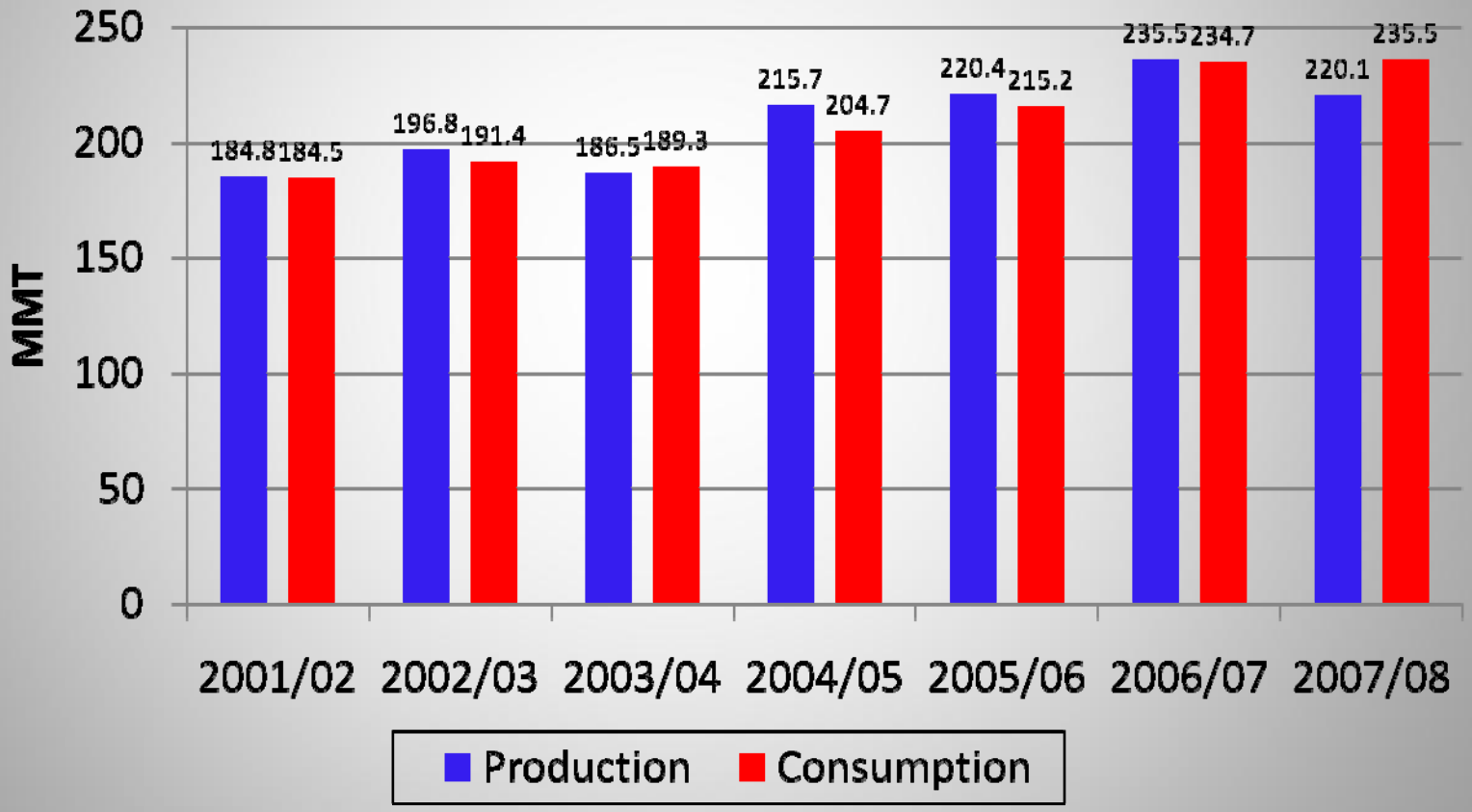
Net Soybean Meal import: 9.6 Million tons

Soybeans, Corn, Wheat, Cotton, and Rice
Percentage Change in Global Consumption
1990/91 – 2006/07 and Forecast for 2007/08

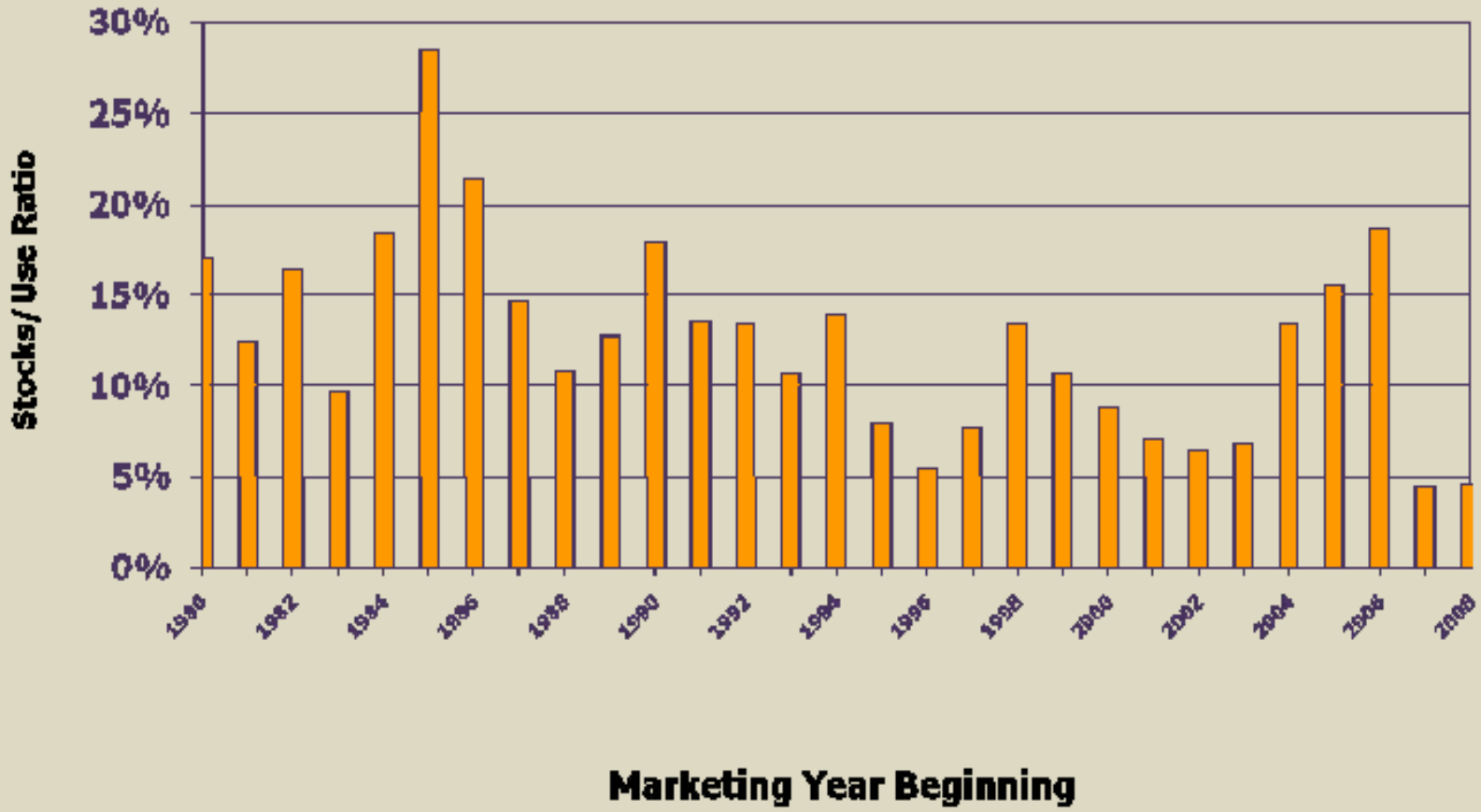


Global Soybean Production and Consumption

2001/02 – 2006/07 and Forecast for 2007/08

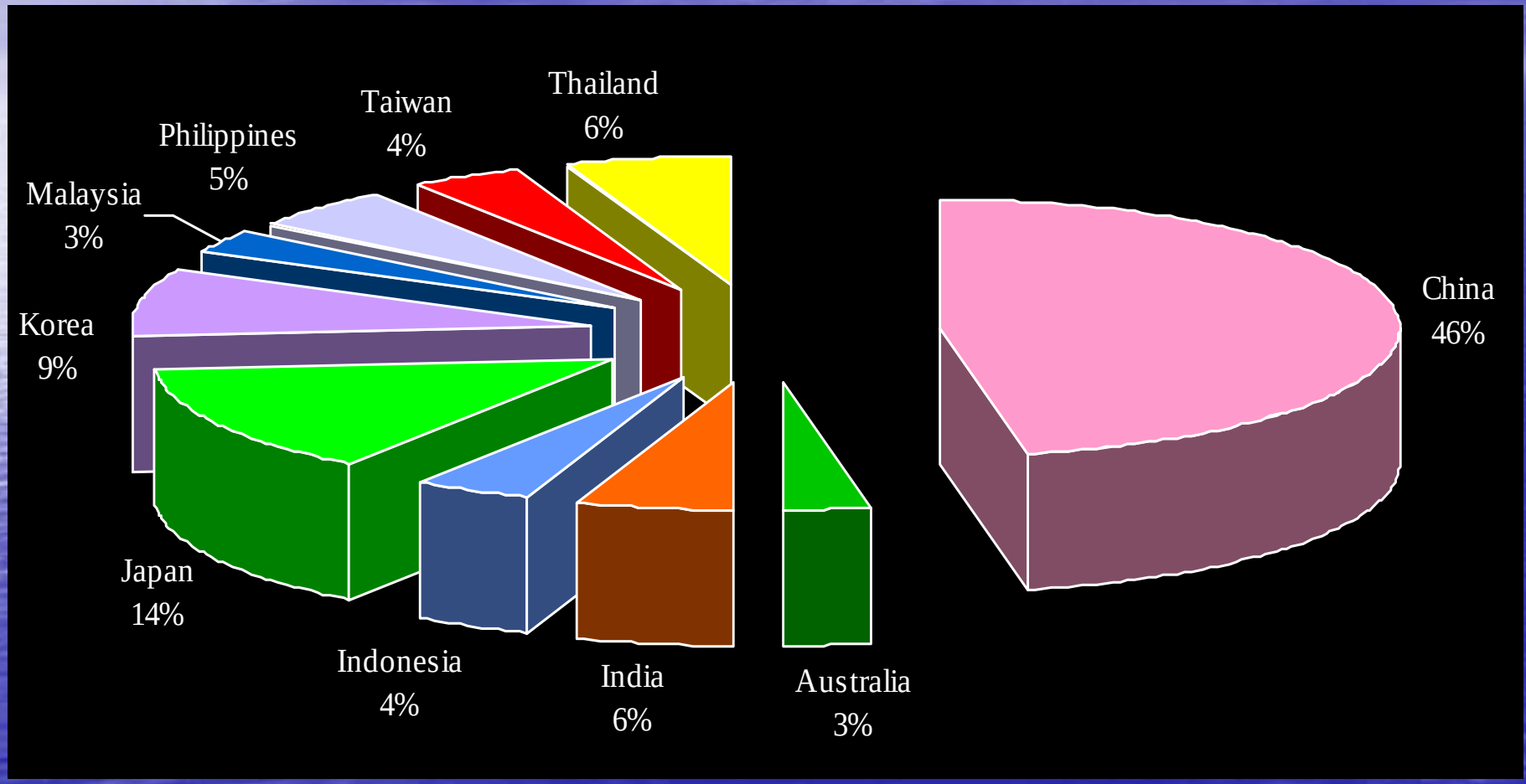


U.S. Soybeans
Ending Stocks to Use Ratio



December 2008 Soymeal Futures

Size of Feed Production, 2007(Asia Pacific)

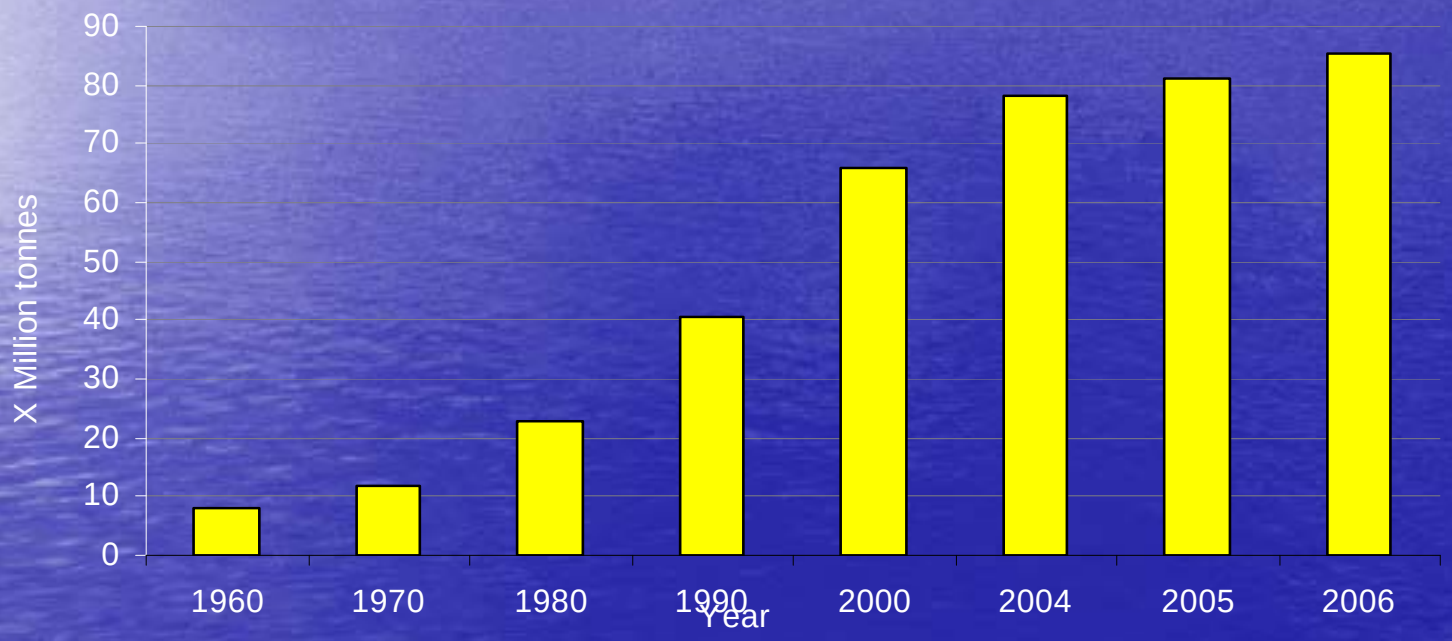


Total Production: 184.7 million tonnes

Reference: Feed International, 2008

Feed International, January 2008

World poultry meat production



The changing contribution of the continents to global poultry meat production (data in %, source FAO)

Continent	1970	1990	2005
Africa	4.0	5.0	4.2
Asia	17.9	24.2	34.0
Europe	28.1	20.6	16.4
USSR	7.1	8.0	-
N and C America	36.2	31.3	28.4
S America	5.8	9.5	15.7
Oceania	0.9	1.2	1.2
World	100.0	100.0	100.0

Issues with the use of Lupins in Asian Food and Feed

- Supply has not been consistent
- Although much research has been done on Lupins replacing soybeans in Asian food, in reality Asian consumers cannot accept the different taste profile
- Lupins may have to create its own niche instead of just replacing soybeans in Asian Soy foods
- No health claims are allowed for Lupins at the moment
- The potential use of Lupins in Asian aquaculture and swine feeding is tremendous. However certain issues may be obstructing its use.
- Most research on the use of Lupins in Aquaculture is done in Australia

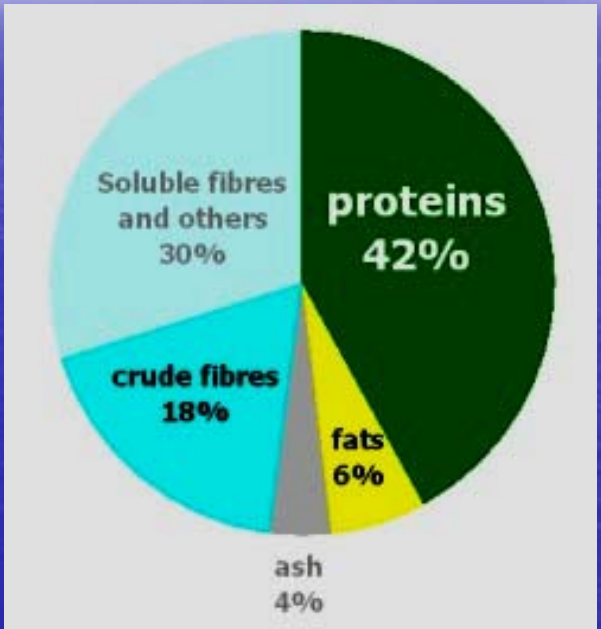
Issues with the use of Lupins in Asian Food and Feed

- For effective use in aquaculture and swine Lupins should be dehulled
- Australian companies have put in dehulling plants, but overseas buyers may prefer to buy lupin seed instead of lupin kernel meal
- However dehulling is not easy and hulls can only be used for ruminant feeding

Opportunities For The Use Of Lupins In Asian Foods base on its functional and nutraceutical properties

Typical composition of Lupin

- High Protein
- High dietary fiber
- Low oil content
- Contant minimal starch
- Low Glycemic Index (GI)



Introduction

- There is much speculation and evidence that soybeans can improve the general health of populations that consume soy based products
- Today, FDA allows claims for Soy foods
- Lupins have been suggested as a potential substitute for soybeans in Asian Soy Foods but the taste profile is different.

Introduction

- The lupin seed is high in protein, high in dietary fiber, low oil content , contains minimal starch and lowest gLycemic Index (GI) of any commonly consumed grain.
- The potential of using lupins as a nutraceutical food supplement and additive in Asian Foods is good
- Lupin flour and lupin fiber can offer functional advantages in Asian Foods

Health benefits of lupins demonstrated in clinical trials

- Reduce the risk of diabetes and cardiovascular disease.
- Lupin flour incorporated into white bread significantly reduced the level of blood glucose (Hall R.S. et al. 2005)
- Lupin fiber act as a soluble fiber and reduces the total cholesterol without affecting the HDL cholesterol.
- Reduces appetite helps prevent obesity

Potential Use of Lupin In Asian Foods

The potential of usage lupin in Asian Foods is tremendous.

Much work has been done by Dr. Mark Sweentingham et al. using lupin to replace soybean in traditional Asian soy foods

Example :

- Soy milk
- Tofu
- Miso
- Shoyu
- Tempeh

We have undertaken research of lupin flour in noodles and meat extender.

Example :

- Noodles
  - -Instant noodle
  - -Wanton noodle
  - -Alkaline noodle




- Meat extender
  - -Sausages
  - -nuggets



Use of lupin flour in instant noodle

Expanding Market

National Trends in Instant Noodles Demands

Updated on April 4, 2008

	Country / Region	2003	2004	2005	2006	2007
1	China, Hong Kong	320.0	390.0	442.6	467.9	501.1
2	Indonesia	112.0	120.1	124.0	140.9	149.9
3	Japan	54.0	55.4	54.3	54.4	54.6
4	USA	37.8	38.0	39.0	40.4	42.4
5	Vietnam	23.0	24.8	26.0	34.0	39.1
6	South Korea	36.0	36.5	34.0	33.7	32.2
7	Philippines	22.0	25.0	24.8	25.0	24.8
8	Thailand	17.2	17.8	19.2	20.5	22.2
9	Russia	15.0	15.2	16.0	16.0	16.0
10	Brazil	11.1	11.5	12.6	13.8	14.3
11	Malaysia	8.2	8.7	8.9	10.6	11.8
12	India	3.0	4.3	5.8	8.0	10.0
13	Nigeria	0.0	6.0	6.5	7.0	10.0
14	Mexico	7.5	10.0	10.0	9.0	9.0
15	Taiwan	10.0	9.5	8.9	8.7	8.5
16	GCC Countries *	0.6	5.0	5.5	6.0	6.7
17	Nepal	3.4	3.7	3.7	3.9	4.3
18	Poland, Hungary, Czech	2.2	2.3	2.3	3.5	3.5
19	UK	2.6	2.6	2.6	2.6	2.6
20	Myanmar	0.7	0.7	0.7	0.7	2.2
21	Cambodia	1.3	1.7	1.7	1.7	2.1
22	Canada	1.5	1.8	1.8	1.9	2.0
23	Germany	1.4	1.4	1.4	1.8	1.8
24	Australia	1.5	1.5	1.5	1.5	1.5
25	Singapore	1.2	1.2	1.2	1.2	1.2
26	Fiji and outskirt islands	0.8	0.8	0.8	0.8	0.8
27	South Africa	0.5	0.5	0.5	0.5	0.5
28	New Zealand	0.4	0.4	0.4	0.4	0.4
29	France	0.4	0.4	0.4	0.4	0.4
30	Norway, Finland, Sweden, Denmark	0.3	0.3	0.3	0.3	0.3
31	Netherlands	0.3	0.3	0.2	0.2	0.2
32	Peru	0.2	0.2	0.2	0.2	0.2
33	Belgium	0.1	0.1	0.1	0.1	0.1
34	Others	2.0	2.0	2.0	2.0	2.0
	Total	698.2	799.7	859.9	919.6	978.7

Unit: 100 million pieces
* Gulf Cooperation Council Countries

Use of Lupin Flour in Instant Noodle

- Lupin Flour was used at 4% to replace wheat flour
- Instant noodles were made using this lupin fortified flour and compared with regular instant noodle made only with wheat flour
- The noodles were evaluated for appearance, eating quality, oil and protein content

Use of Lupin Flour in Instant Noodle

- Flour sample analysis:

	Control	Fortified with 4% Lupin flour
Moisture (%)	13.0	13.0
Protein (%)	11.0	12.0
Ash (%)	0.51	0.60
Farinograph water absorption (%)	63.5	64.5
Color, L (brightness) b (yellowness)	91.30 9.89	91.57 11.34

Use of Lupin flour in Instant Noodle

- Instant noodle analysis results :

	Control	Fortified with 4 % Lupin flour
Moisture (%)	4.9	4.3
Protein (%)	10.2	10.9
Oil (%)	19.3	16.3
Color, L (brightness) a (yellowness)	74.12 18.95	74.95 22.06

Use of Lupin flour in Instant Noodle

Advantages :

- Improved noodles appearance (brighter color)
- Improved eating qualities (smoother mouth feel)
- Reduce fat contents by 3.0%
- Increase protein level by 0.7%

Control 4% Lupin flour

Use of lupin flour in wanton noodle

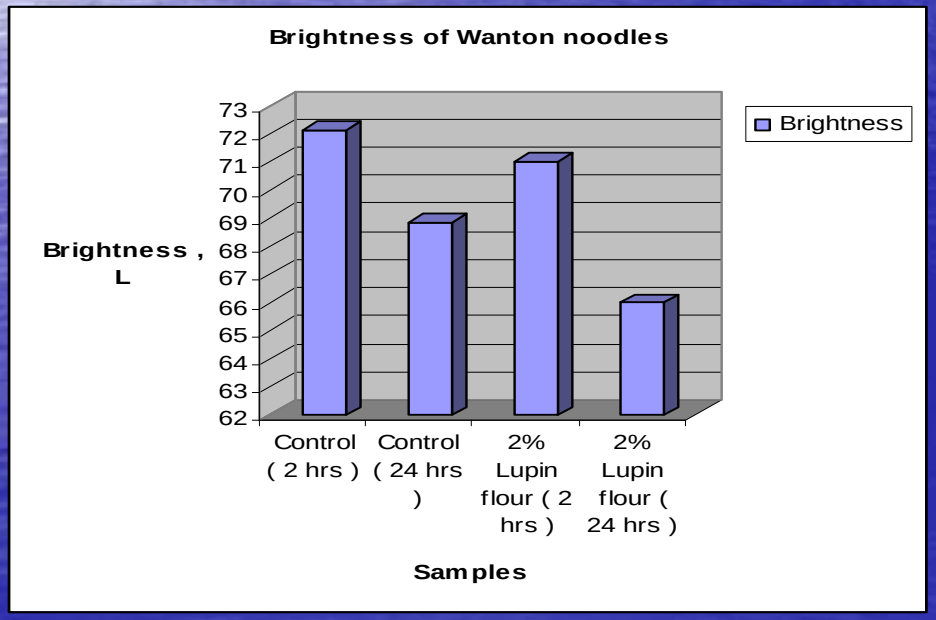
Use of Lupin in Wanton Noodles

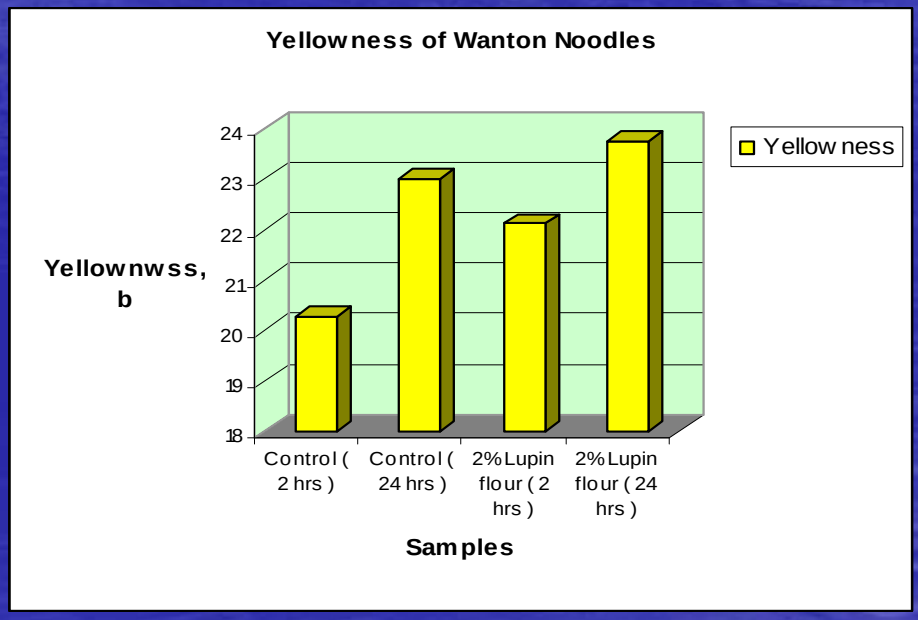
- Lupin Flour was used at 2% to replace wheat flour
- Wanton noodles were made using this lupin fortified flour and compare with regular wanton noodle made only with wheat flour
- The noodles were evaluated for appearance, color stability and eating quality

Use of Lupin flour in Wanton Noodle

Wanton noodle color result :

	Control		Fortified with 2 % Lupin flour	
Hours	2 hours	24 hours	2 hours	24 hours
Color				
L (brightness)	72.11	68.84	71.02	65.99
b (yellowness)	20.28	22.99	22.12	23.74





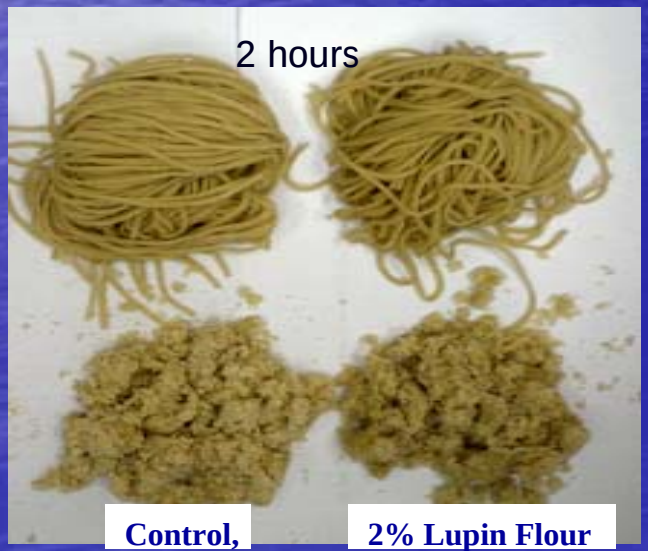
Use of Lupin flour in Wanton Noodle

Advantages :

- Improved eating qualities (firmer)
- More yellowish color

Disadvantages :

- Darker noodle colour after 24 hours (poor color stability)



Use of lupin flour as a meat extender in sausages compared with Soy flour and control

- Meat sausages are very popular in Asia.
- In recent years, the consumption of chicken frankfurters has increased tremendously in Asian countries
- Normally soy flour and soy concentrates are used to extend the meat protein and increase moisture retention of sausages after cooking

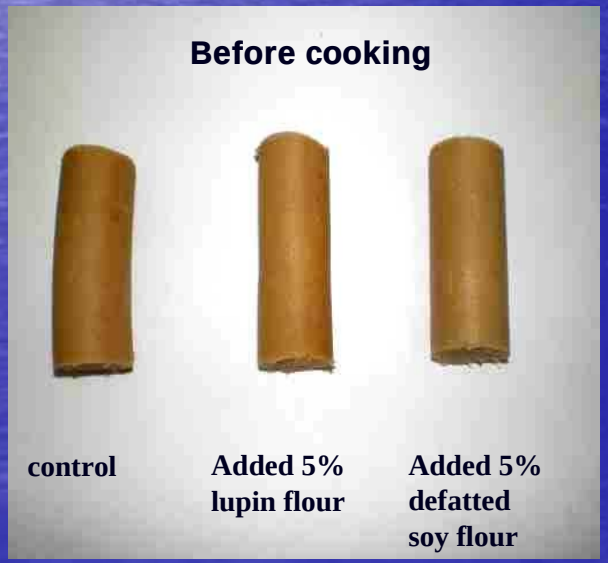
Use of Lupin flour in sausages as a meat extender compare with Soy flour

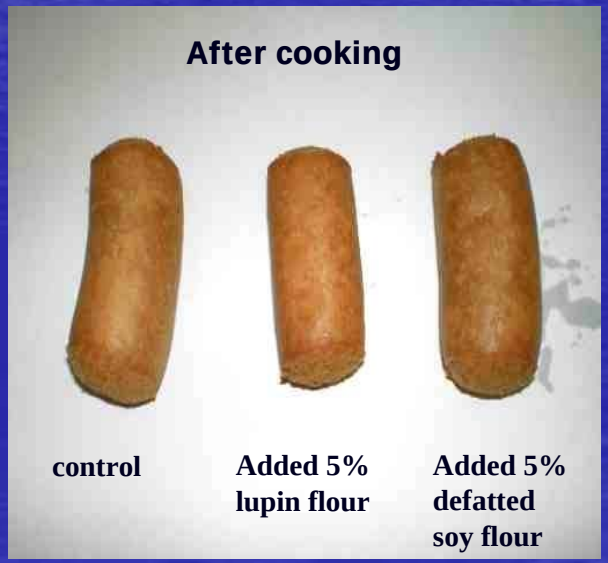
- Lupin Flour and defatted soy flour was used at 5% to replace chicken meat and compare with control (without lupin and soy flour)
- Chicken frankfurter were made using meat fortified with lupin flour or defatted soy flour and compared with regular chicken frankfurter made only with chicken meat.
- The chicken frankfurters were evaluated for appearance, eating qualities, oil content and moisture retention after cooking.

Use of Lupin flour in sausages as a meat extender compared with Soy flour

Table 4: Moisture and oil content in sausages made from lupin flour, defatted soy flour and control

	Control	Added 5% lupin flour	Added 5% defatted Soy flour
Moisture (%)	55.3	60.4	61.5
Oil content (%)	4.19	5.36	2.92





Use of Lupin flour in sausages as a meat extender compared with Soy flour

Advantages :

- Significantly higher moisture content after cooking
- Indistinguishable in taste from Control and the sausage using soy flour
- No shrinkage was observed after cooking

Disadvantages :

- Darker sausage colour

A New Opportunity for Lupins

- Most of the soybeans grown in USA and Argentine are genetically modified (GMO)
- Most of of the consumers are resistant to GMO foods
- Lupin are non GMO, it can be a cost effective non GMO replacer for soybeans

Conclusion

- Sweetingham et al. has shown the lupin can replace soybeans in soy food such as soymilk, tofu, tempeh, miso etc. However currently Asian consumers may not like the taste profile of Lupins

- Our own research shows that lupin flour can improve the eating quality of instant noodles while reducing the oil content and increasing the protein content at the same time

Conclusion

- Lupin flour can also be used as a meat extender in sausages with a similar performance to soy flour
- The consumption of instant noodle and meat sausages are increasing rapidly in Asian countries. These two product can offer big opportunities for lupin flour

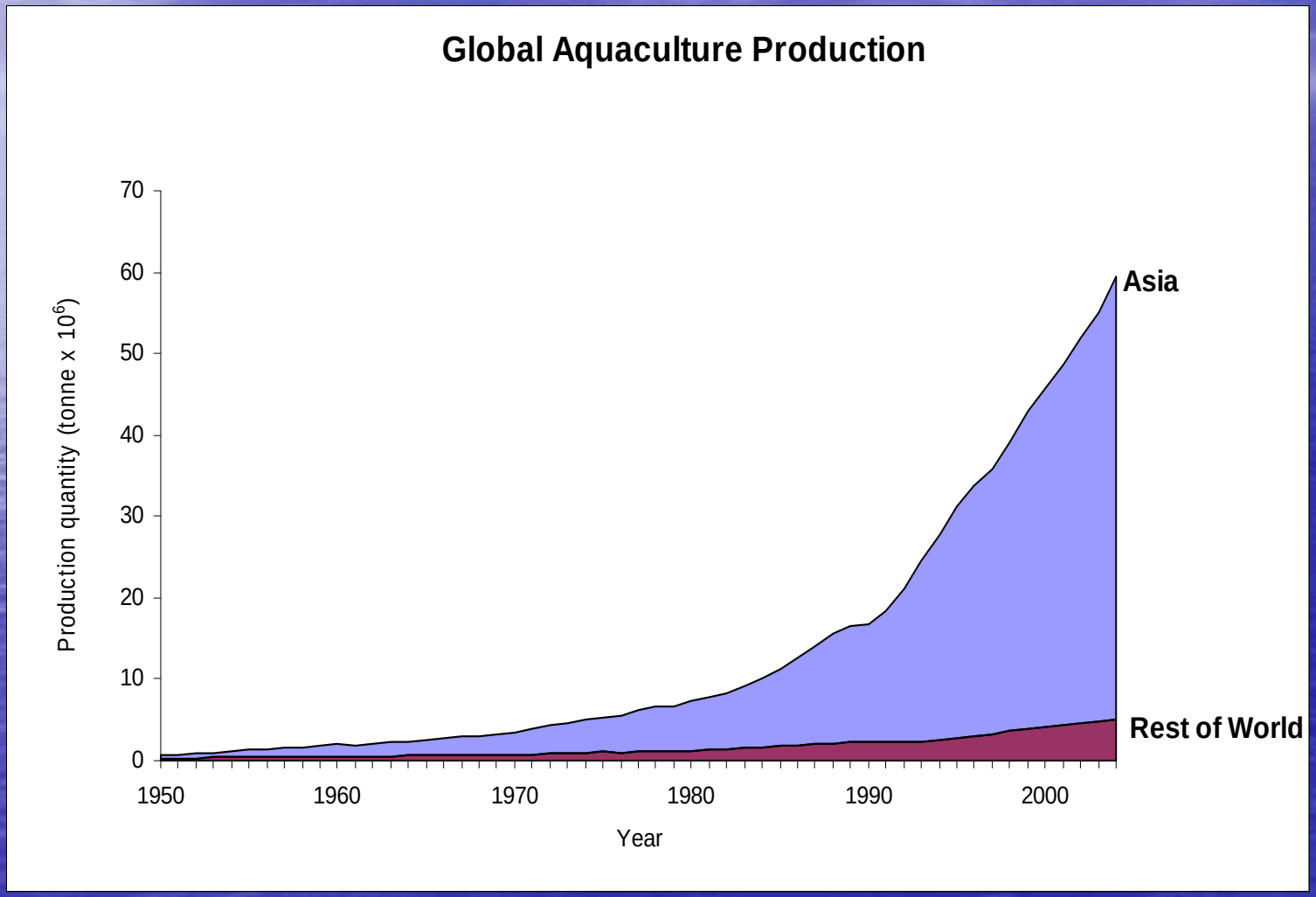
Potential use of Lupins in Asian Animal Feeds

Nutrient composition of Lupins vs Soybean Meal

Nutrient	Yellow lupin *(L. luteus)*	White lupin *(L. albus)*	Sweet lupin *(L.angustifolius)*	Soybean meal
Dry matter content (g/kg)	937	922	910	890
Crude protein (g/kg DM)	496	455	411	503
Total Nitrogen (g/kg DM)	79	73	66	80
Crude fat (g/kg DM)	55	137	60	12
Ash (g/kg DM)	38	36	32	88
Nitrogen-free extractives (g/kg DM)	410	405	497	397
Phosphorus (g/kg DM)	5	5	4	7
Gross energy (MJ/kg DM)	**21.0**	**23.1**	**20.7**	**19.2**
Lysine (g/kg DM)	22.8	19.5	18.1	33.9
Threonine (g/kg DM)	15.7	16.4	14.4	22.7
Methionine (g/kg DM)	3.8	3.0	3.1	8.4
Isoleucine (g/kg DM)	16.3	18.7	16.3	24.9
Leucine (g/kg DM)	35.4	31.4	27.7	42.1
Valine (g/kg DM)	16.7	17.5	15.7	26.9
Arginine (g/kg DM)	47.0	51.8	44.3	39.8

Use of Lupins in Aquaculture Feeds

Size of Aquaculture Production



Source : FAO, Rome

Performance of Lupins in Aquaculture Diets

Rainbow Trout

- The apparent digestibility of lupin (L.albus) protein was higher than full fat soybean meal, 85.2 % vs 79.5%. (Hughes, 1988)
- Dehulled lupin (L.albus) outperformed full fat soybean in fish growth trial. The final weight was 36.8g and 37.7g respectively for diet using full fat SBM and dehulled lupin. FCR was 1.45 for full fat diet and 1.39 for lupin diet (Hughes, 1991)

Performance of Lupins in Aquaculture Diets

Digestibility values of a range of protein resources, including L.angustifolius whole seed meal, fed to rainbow trout. Data derive from Gomes et al. (1995)

	Protein Digestibility, %	Energy Digestibility,%
Fishmeal	86.6	69.7
L. Angustifolius whole seed meal	85.5	61.2
Full Fat Toasted SBM	86.4	80.2
Full fat micronized SBM	96.3	90.7
Faba bean meal	80.2	60.2
Pea seed meal	80.4	59.2
Corn gluten meal	95.3	91.8
Meat meal	90.8	92.1

Performance of Lupins in Aquaculture Diets

Atlantic salmon

- Study comparing the biological value of fishmeal, SBM and dehulled lupin meal (L angustifolius) conducted by Carter and Hauler , 1999 showed that

  - FCR (g fed/g gain) was 1.7, 1.7 and 1.4

  - nitrogen retention (%) was 44.5, 44.2 and 52.7

  - Apparent Protein digestibility (%) was 90.5, 92.0 and 91.3

  - Apparent phosphorus digestibility (%) was 39.8, 27.5 and 46.7

Why Lupins can be better than soybean meal in Aquaculture

- Good quality protein or amino acids. The AA profile of yellow lupin is similar to soybean meal
- High digestibility of protein / amino acids
- Low anti nutritional factors such as lectins and trypsin inhibitors. No heat treatment required and therefore heat damage of protein can be avoided.
- Contain lower phytate
- Inherent oil content of 6-8% contain mostly of the linoleic and oleic acids.

Proper Processing of Lupins required

- To use in Aquaculture
  - Dehulling
  - Micronizing

- Problem :

  -dehulling equipment not available in Asian feedmills and hull disposal is a problem.

Use of Lupins in Swine Feeds

Performance of Lupins in Swine Diets- Yellow Lupin

Experiments conducted at the Medina Research Centre. Journal of Agriculture vol 42, Oct 2001

1. No significant difference in growth rate, feed intake and FCR when 20% of yellow lupin was included in weaner pig diet. This indicate that yellow lupin can be used to replace soybean meal in weaner diet without any adverse effect on performance.
2. Similar results were found for grower pig trial when 26% of yellow lupin was used in grower diet.

3. Effect of inclusion rate of yellow lupin on liveweight (LW), average daily gain (ADG), voluntary feed intake (VFI) and feed conversion ratio (FCR) of pigs from weaning to sale

	Control	Yellow Lupin inclusion rates,%		
		Low	Medium	High
LW 5kg		5	8	15
LW 20kg		10	16	22
LW 50kg		15	23	27
ADG, g	962	1002	971	911
FI, g/d	2.16	2.22	2.12	1.99
FCR	2.25	2.22	2.19	2.19

Performance of Lupins in Swine Diets- L. Angustifolius

- L. angustifolius can be used in pig diets at high levels without affecting feed intake and performance.

  - use up to 43% in diet (wheat based) offered to pig weighing 6-15kg. Barnet & Batterham, 1981.

  - up to 37% in the weaner diet. Pearson & Carr, 1976.

Pig Feeding Trial conducted by Soon Soon replacing 75% of the soybean meal with a sweet lupin meal specially processed to maximize nutrient availability

Trial conducted at University of Agriculture Malaysia

Method and Material

Pigs :

- 60 cross bred starter pigs
  (Landrace x Large White x Duroc)

No of treatment :

- 2 treatments with 30 starters in each group

No of replicate :

- 10 replicates per treatments
- 3 starters per pen; total of 20 pens were used

Duration of trial :

- 56 days (8 weeks)

Measuring Parameters

- Average Daily Gain (ADG)
- Average Daily Feed Intake (ADF)
- Feed Conversion Ratio (FCR)

Grower Feed Composition

Ingredients	Control Diet	Lupin Diet
Corn, g/kg	578.7	578.7
Dehulled Soybean meal, g/kg	225.5	56.4
Dehulled Lupins meal, g/kg	0	169.1
Wheat pollard, g/kg	129.5	129.5
Fish meal 60, g/kg	30	30
Limestone, g/kg	11.1	11.1
Crude palm oil, g/kg	10	10
MDCP, g/kg	8	8
Vitamin Premix, g/kg	4.2	4.2
Salt, g/kg	2.5	2.5
L Lysine, g/kg	0.3	0.3
L Throenine, g/kg	0.1	0.1
Choline Chloride, g/kg	0.1	0.1

Calculated Nutrients Grower Feed

Nutrients	Control Diet/ Lupin Diet
Metabolizable Energy, Mj/kg	12.97
Crude Protein, g/kg	174
Crude fat, g/kg	42
Lysine, g/kg	9.49
Methionine, g/kg	0.297
M+C, g/kg	0.595
Tryptophan, g/kg	0.20
Threonine, g/kg	0.664
Dig. Lysine, g/kg	0.792
Dig. Methionine, g/kg	0.256
Dig. M+C, g/kg	0.478
Dig. Tryptophan, g/kg	0.162
Dig. Threonine, g/kg	0.523

Results

	Control Diet	Lupin Diet
Initial body weight (kg)	21.93±0.73[a]	22.21±0.63[a]
Average feed intake (kg/day/pig)	1.59±0.06[a]	1.36±0.05[b]
Final body weight (kg)	53.93±1.71[a]	53.42±1.47[a]
Total Live weight gain, g/day/pig	571.43±16.18[a]	563.90±17.15[a]
Feed conversion ratio	2.79±0.10[a]	2.41±0.09[b]

Discussion

- Initial body weight, total live weight gain and final body weight were not statistically significant ($P>0.05$).
- feed intake and feed conversion ratio for the pigs offered lupin diet were significantly lower ($P<0.05$). It was 13.6% better.

Conclusions

- Lupins have great potential in Asian aquaculture and pig feeds.
- When it is processed correctly, it can perform better than soybean meal.
- Lupins should be dehulled and micronized to be effective in aquaculture.
- Yellow lupin has the greatest potential but supply is limited.

Suggestions on ways to make Lupins more competitive for Asian Foods and Feeds

- Breed to reduce seed coat thickness, currently dehulling loses are 25-30% vs 6-7% for soybeans
- Either make Luteus work or increase protein of Angustifolius
- Set up a Lupin marketing entity similar to the American Soybean Association or US Grain Council
- Ensure good marketing materials are available especially application manuals
- Conduct application research in Asia
- Don’t try to do all the downstream processing of lupins in Australia
- Focus on Aquaculture and Pig feeding
- Get FDA to endorse Lupin’s health claim

Thank You