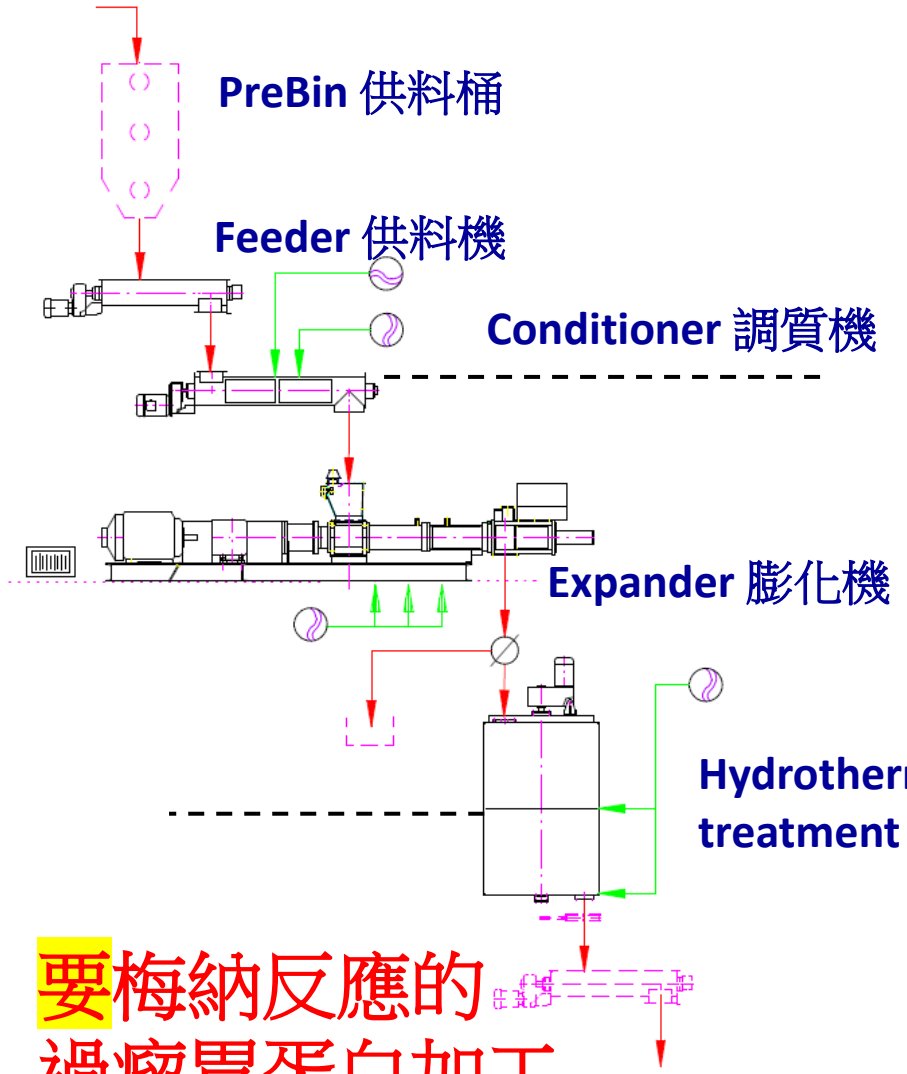
Mono-Component Treatment
單味原料處理
~ 談動物精準營養，從適當與準確的加工開始 ~

Authorized by: Olaf Nahrig, Amandus Kahl
主講人：周震煌 日期：2023/12/20
正同開發股份有限公司副總經理
國立台灣大學 生物機電工程學研究所 博士
國立台灣大學動科系(所) 飼料製造學 專任業師
國立屏東科技大學動畜系兼任助理教授

Crown Expander Technology for
piglet, broiler and dairy cattle
冠型膨化機處理技術適用於仔豬、肉雞和乳牛的原料

Superior and digestion optimized treatment for
full fat soya, plant protein, corn, wheat, extraction meals
針對全脂豆粉、植物蛋白質、玉米、小麥等粉料有
卓越且最佳消化率的處理

Mono Components Treatment 單味原料處理



~溫度~

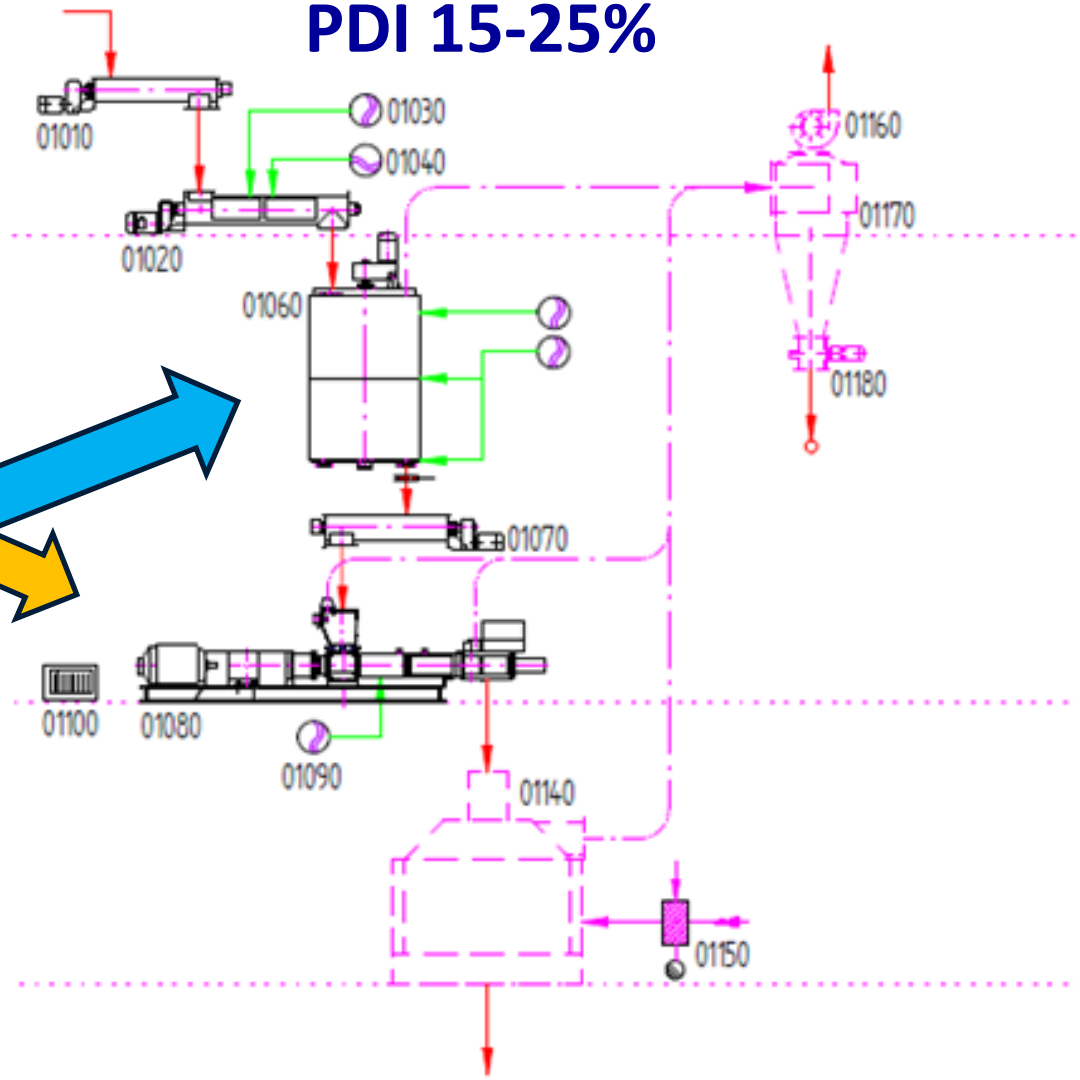
~水份~

~時間~

要梅納反應的過瘤胃蛋白加工

無梅納反應的(全脂)豆粉加工

PDI 15-25%



Bypass Protein過瘤胃蛋白質

‘Bypass’ or ‘Rumen Escape’ protein is simply a protein that is less likely to be digested by rumen microbes. Cows need nutrients to produce milk. The bacteria in the rumen provide them with both energy and protein as they digest grass. Heat processing of feed decreases protein degradation in the rumen by denaturing proteins and the formation of protein-carbohydrate cross-links called as Maillard reaction and protein-protein cross-links

過瘤胃蛋白質，是一種不太可能被瘤胃微生物消化的蛋白質。乳牛需要營養才能產奶，瘤胃中的細菌在消化草時為它們提供能量和蛋白質。飼料(原料)的熱處理透過使蛋白質變性和形成蛋白質-碳水化合物交聯反應，即所謂的梅納反應，以及蛋白質-蛋白質的交聯作用，來減少瘤胃中的蛋白質降解。

Maillard Reaction 梅納反應

The Maillard reaction is a non-oxidative browning, i.e. a caramelization and/or reaction of carbohydrates with protein or nitrogen compounds as a result of excessive heat. The protein and the essential amino acids are damaged above all. This has a negative effect on the digestibility of the proteins and amino acids. During the reaction a part of the lysine is lost.

梅納反應是一種非氧化褐變反應，是由於**過熱**導致**碳水化合物**與**蛋白質**或**氮化合物**發生焦糖化反應，當中蛋白質和必需氨基酸遭到破壞。這對蛋白質和氨基酸的消化率有負面的影響。在反應過程中，一部分賴氨酸遺失。

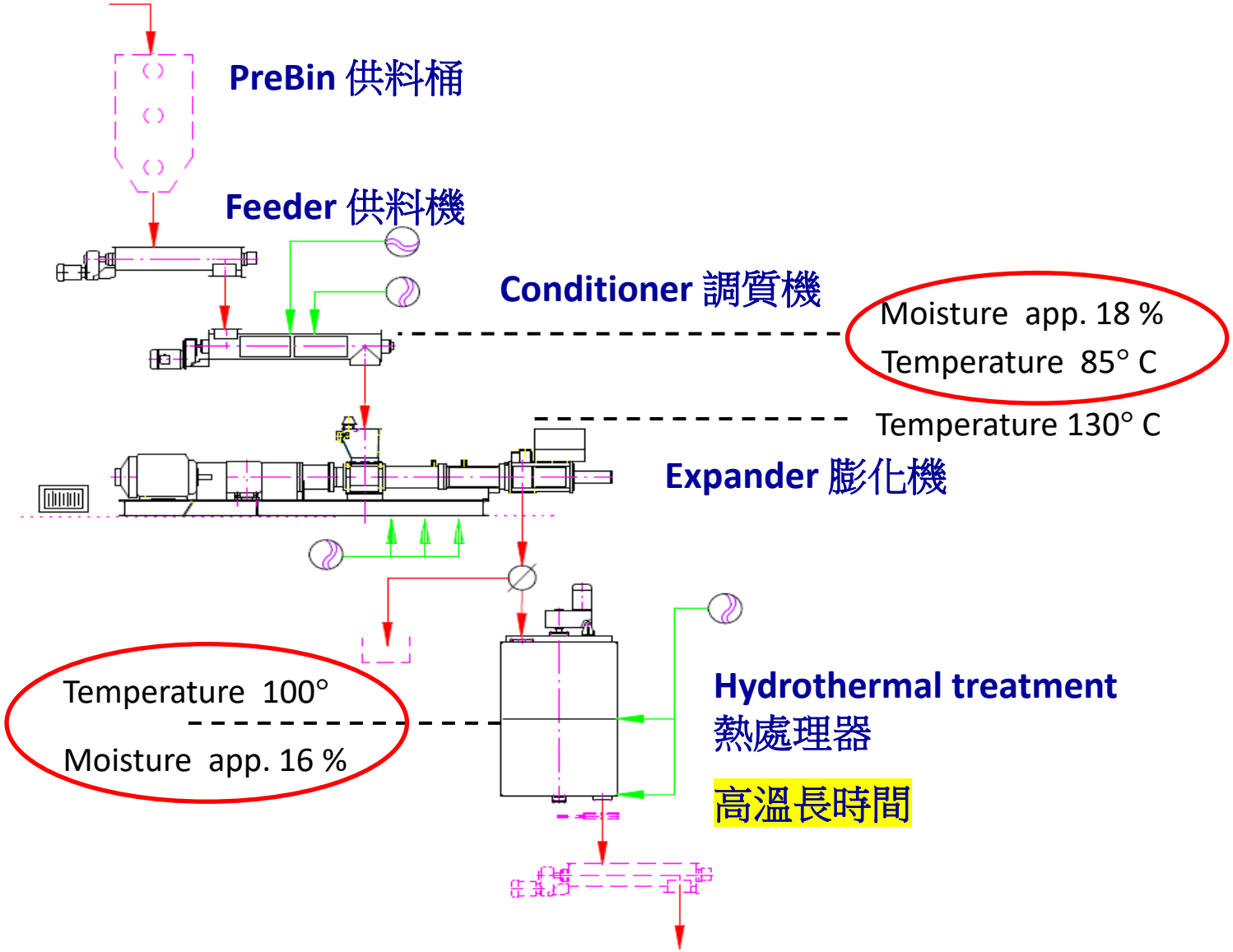
Mono Components 單味原料

1. By Pass Proteins for dairy cattle
   乳牛過瘤胃蛋白
2. Full Fat Soya for Piglets and Broilers
   小豬料和肉雞料的全脂黃豆粉
3. Starch gelatinization for Piglets
   小豬料的澱粉糊化
4. Soy bean extraction meal treatment for Piglets
   小豬料的脫脂黃豆粉處裡

By Pass Protein Treatment with Expander

用膨化機處理過瘤胃蛋白

UDP – Bypass Protein 未消化蛋白-過瘤胃蛋白處理



Bypass Protein- ruminant 反芻動物過瘤胃蛋白熱處理

soya-extraction meal *crownexpanded *脫脂豆粉用膨化機處理*	Before 處理前的	After 處理後的
Protein solubility	15,8	8,3
A (NPN)	1,6	5
B 1 (buffer soluble true protein)	14,3	4,7
B 2 (buffer-insoluble true protein)	79,1	73,0
B 3 (cell wall bounded soluble true protein)	2,9	17,0
C (cell wall bounded insuluble true protein)	2,1	2,5
通過瘤胃進入小腸的蛋白質比例； **2**小時 **5**小時 **8**小時後測到的過瘤胃蛋白		
UDP 2	4	60
UDP 5	21	80
UDP 8	31	85

Increase of milk yield of cows

Source: BlggDE analytic 2016

Results of the feed trial 飼料測試結果

Feed trials from 19. January – 15. Februrary 2017
飼料測試從2017年1月19日-2月15日

→Higher milk yield approx. 0.75 l
牛乳產量高出0.75公升
→Less cost for feed mixture: approx. 0.03 €/l
飼料成本節省0.03 €/升

Annual savings of 240 € per cow per year using Expanded feed
用膨化料每年每頭牛省240歐元

Rape seed meal 菜籽粕

Fig.1: Rapeseed plant

Fig.2: Rape seed meal

Tab.1: Rapeseed meal natural

Ingrediens	Unit/ DM	Approx.
Crude protein	%	38
Useable protein nXP/UDP	%	30
Digestibility protein	3 h/ %	80
Crude fibre	%	12
Crude fat	%	2,5
Gross Energy ME - VQ	MJ	19.4
Gas accumulation	%	25
Glucosinolates (ANF)	µmol/g	20

Tab.2: Rapeseed meal expander treated

Useable protein nXP/UDP	%	65 – 80*
Digestibility protein	3 h/ %	85 – 90*
Gross Energy ME - VQ	MJ	20.2 – 21.4*
Gas accumulation	%	45 – 50*
Glucosinolates (ANF)	µmol/g	< 3 – 5.1*

Ruminants

Monogasters

* Minimum value with expander treatment
* Maximum value 35 kWh/t SEM expander or with postconditioning

Flaxseed meal 亞麻籽粕

Fig.3: Flax plant

Fig.4: Flaxseed meal

Tab.3: Flaxseed meal natural

Ingrediens	Unit/ DM	Approx.
Crude protein	%	34
Useable protein nXP/UDP	%	25
Digestibility protein	3 h/ %	85
Crude fat	%	10.5
Digestibility fat	3 h/ %	86
Gross Energy ME - VQ	MJ	19.4
Hydrocyanic acid (ANF)	mg/g	8

Tab.4: Flaxseed meal expander treated*

Useable protein nXP/UDP	%	50 – 75*
Digestibility protein	3 h/ %	90 – 95*
Digestibility fat	3 h/ %	89 – 96*
Gross Energy ME - VQ	MJ	20 – 21.4*
Hydrocyanic acid (ANF)	mg/g	< 2 – 4*

* Maximum value with 35 kWh/t SEM or with postconditioning

Cotton seed meal 棉仔粕

Fig.5: Cotton plant

Fig.6: Cotton seed meal natural

Tab.5: Cotton seed meal natural

Ingrediens	Unit/ DM	Approx.
Crude protein	%	47
Useable protein nXP/UDP	%	20
Digestibility protein	3 h/ %	72
Crude fibre	%	13
Gross Energy ME - VQ	MJ	20.2
Gas accumulation	%	30
Gossypol (ANF)	%	0.3

Tab.6: Cotton seed meal expander treated*

Useable protein nXP/UDP	%	45 – 60*
Digestibility protein	3 h/ %	76 – 81*
Gross Energy ME – VQ	MJ	20.6 – 21.2*
Gas accumulation	%	45 – 60*
Gossypol (ANF)	%	0.06 – 0.15*

* Minimum value with expander treatment
* Maximum value with 35 kWh/t SEM expander or expander with postconditioning

Copra 椰子粕

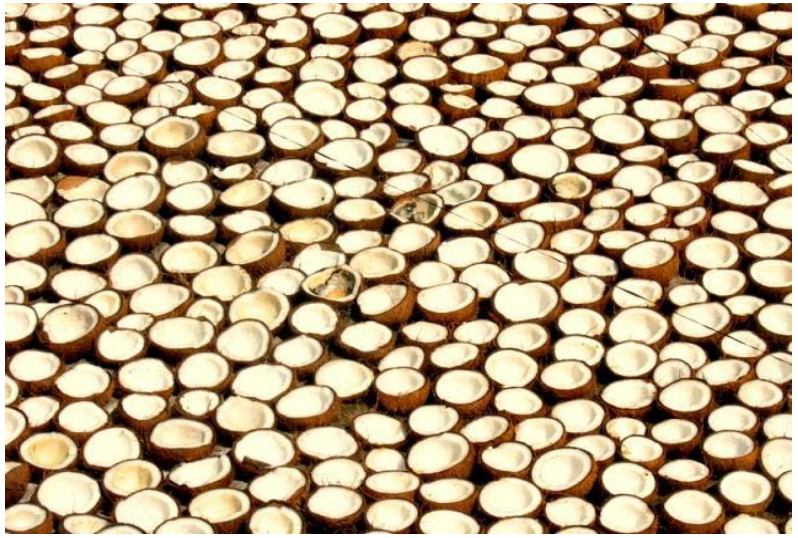


Fig. 7.: Coconut

Fig. 8: Copra meal natural

Tab.7 : Copra meal natural

Ingrediens	Unit/ DM	Approx.
Crude protein	%	22.4
Useable protein nXP/UDP	%	15
Digestibility protein	3 h/ %	80
Crude fibre	%	14.1
Gross Energy ME - VQ	MJ	19,8
Digestibility energy	3 h/ %	78.9
Gas accumulation	%	32

Tab.8: Copra meal expander treated*

Useable protein nXP/UDP	%	25 – 35*
Digestibility protein	3 h/ %	85 – 87*
Digestibility fibre	3 h/ %	45 – 55*
Gross Energy ME - VQ	MJ	20.5 – 21,2*
Digestibility energy	3 h/ %	82.5 – 86.9*
Gas accumulation	%	42 – 56*

* Minimum value with expander treatment
* Maximum value with 35 kWh/t SEM expander or with postconditioning

Palm seed meal油棕粕

Fig. 9: Palm plant

Fig.10: Palm seed meal natural

Tab.9: Palm seed meal natural

Ingrediens	Unit/ DM	Approx.
Crude protein	%	18.7
Useable protein nXP/UDP	%	20
Crude fibre	%	19.8
Crude fibre digestibility	3 h/ %	35.2
Gross Energy ME - VQ	MJ	20.1
Digestibility energy	3 h/ %	68.9
Gas accumulation	%	25
Tannin	%	0.42

Tab.10: Palm seed meal expander treated *

Useable protein nXP/UDP	%	39 – 50*
Crude fibre digestibility	3 h/ %	40 – 45.1*
Gross Energy ME - VQ	MJ	20.6 – 21.3*
Digestibility energy	3 h/ %	72 – 77.8*
Gas accumulation	%	35 – 55*
Tannin	%	0.09 – 0.2*

* Minimum value with expander treatment

* Maximum value 35 kWh/t SEM expander or with postconditioning

Trends – High Quality Components for Piglet

趨勢 - 小豬料高品質原料

Reference Quality Data for Top Customer

頂級客戶的品質數據參考

Cargill - SCA Plant in Spain + Tianjin Plant in China

trigo cocido y extrusionado

PIGLETWHEAT 85

INGREDIENTES

Granos de trigo molidos y procesados hidrotérmicamente con parámetros de temperatura, tiempo y humedad específicos

ORIGEN

Pigletwheat 85 es una materia prima de alta calidad elaborada a base de variedades de trigo naturales, de siembra certificada.

INDICACIONES

Pigletwheat 85 está especialmente indicado para dietas de iniciación de lechones aportando almidones de alta digestibilidad y rápida absorción para el lechón.

CARACTERÍSTICAS

- Aporte nutricional de alta digestibilidad mínimo 85% de liberación de glucosa a los 50 minutos de la ingesta.
- Alta palatibilidad para una mayor ingesta.
- Gelatinización de almidones mínima del 60%.
- Complemento ideal de los núcleos SCA para la elaboración de dietas de lechones.

Alimentos para el inicio de una vida

SCA

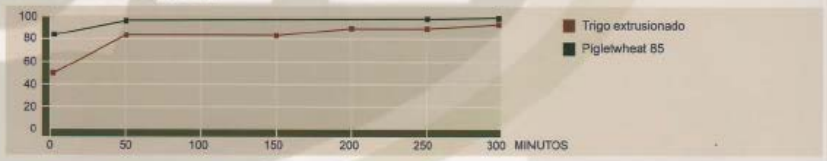
trigo cocido y extrusionado

PIGLETWHEAT 85

ANÁLISIS DEL PRODUCTO

COMPOSICIÓN QUÍMICA	VALORES ESTANDAR	UNIDAD DE MEDIDA
Grasa	1,5	%
Proteína	11,3 min 10	%
Fibra	2,3	%
Cenizas	1,5	%
ED	3.580	kcal/kg
Humedad	< 12 max 13	%
Gelatinización	> 60	%
Almidón	60	%
FND	< 10	%
Liberación de Glucosa (50 min)	85 mínimo	%
Calcio	0,04	%
Fósforo T	0,37	%
Fósforo disponible	0,19	%
K	0,42	%
Na	0,02	%
Cl	0,06	%
Lisina	0,31	%
Met	0,18	%
Met + Cis	0,4	%
Treo	0,32	%
Trip	0,13	%
EN	2.681	kcal/kg
EM	3.472	kcal/kg

LIBERACIÓN DE GLUCOSA



PRESENTACIÓN Y EMBALAJE

- Pigletwheat 85 se suministra en pellet de 12mm de diámetro.
- Pigletwheat 85 se suministra en harina, de diferentes diámetros de moltura, desde 2mm hasta 10mm, según especificaciones de cada cliente.
- Pigletwheat 85 se suministra en forma de migajas con parrilla de 10mm.
- Disponible a Granel, en Big Bag de 1 Tm y en Saco de 25 kg

PIGLETWHEAT 85

Alimentos para el inicio de una vida

SCA

SCA Ibérica S.A.
Polígono Industrial Riols
50170 Mequinenza - Zaragoza
Tel. 974 465412 - Fax. 974 465413
www.scaiberica.com

Cargill - SCA Plant in Spain + Tianjin Plant in China

soja cocida y extrusionada

PIGLETSOY 88

INGREDIENTES

Habas de soja naturales molidas y procesadas hidrotérmicamente con parámetros de temperatura, tiempo y humedad específicos.

ORIGEN

Pigletsoy 88 es una materia prima de alta calidad elaborada a base de variedades de habas de soja naturales, de siembra certificada.

INDICACIONES

Pigletsoy 88 está especialmente indicado para dietas de iniciación de lechones, convirtiéndose en un indispensable aporte proteico y energético de alta digestibilidad y de rápida absorción por parte del lechón.

CARACTERÍSTICAS

- Aporte proteico de alta digestibilidad (min. 88% digestibilidad de proteína.)
- Alta palatibilidad para una mayor ingesta.
- Mínima presencia de factores antinutricionales, garantizando menos de 2,5 mg/g de inhibidores de tripsina.
- Mínima presencia de factores alergénicos (lecitinas, glicina, conglicina)
- Presencia mínima de ureasa, garantizando menos de 0,3 mg/kg.
- Solubilidad del nitrógeno estable en valores cerrados entre 18 y 24%.
- Complemento ideal de los núcleos SCA para la elaboración de dietas de lechones.

Alimentos para el inicio de una vida

SCA

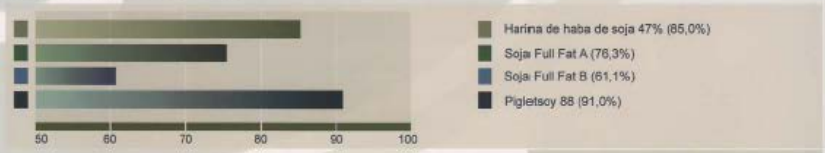
soja cocida y extrusionada

PIGLETSOY 88

ESPECIFICACIONES TÉCNICAS

COMPOSICIÓN QUÍMICA	VALORES ESTANDAR	UNIDAD DE MEDIDA
Grasa	17,80 - 20,00	%
Proteína	34,50 - 36,50	%
Fibra	5,5 max 6,0	%
Cenizas	5,0	%
ED	4.280	kcal/kg
Humedad	< 11 max 12	%
Lisina	2,27	%
Metiodina	0,5	%
Met + Cis	1,07	%
Treonina	1,42	%
Triptófano	0,48	%
Inhibidores de Tripsina	< 2,5	mg/g
Solubilidad del Nitrógeno	18 - 24	%
Ureasa	0,3	mg/kg
Cal	0,25	%
Fósforo	0,56	%
Fósforo disponible	0,18	%
K	1,7	%
Na	0,02	%
EN	3.000	kcal/kg
EM	3.894	kcal/kg

DIGESTIBILIDAD DE PROTEÍNA



PRESENTACIÓN Y EMBALAJE

- Pigletsoy 88 se suministra en harina, en diferentes diámetros de moltura, desde 2mm hasta 10mm, según especificaciones de cada cliente.
- Disponible a Granel, en Big Bag de 1 Tm y en Saco de 25 kg

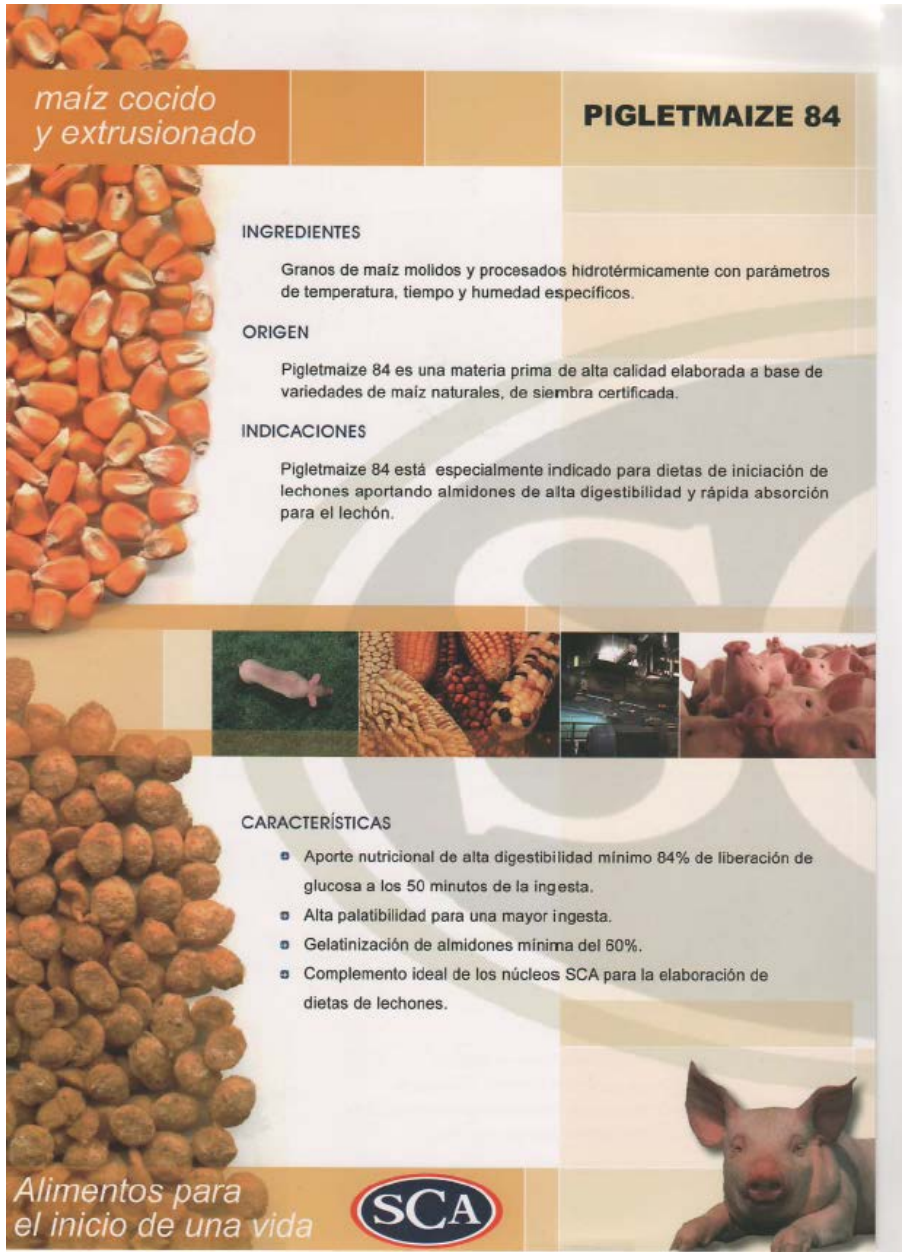
PIGLETSOY 88

Alimentos para el inicio de una vida

SCA

SCA Ibérica S.A.
Polígono Industrial Riols
50170 Mequinenza - Zaragoza
Tel. 974 465412 - Fax. 974 465413
www.scaiberica.com

Cargill - SCA Plant in Spain + Tianjin Plant in China



Danis Belgium – European Top Producer of Full Fat Soya Products

FORTA

FORTA®
A concentrate of soybeans

Forta is the concentrate of heat-treated soybeans, a new and alternative protein and energy source with an original approach for your raw material choice.
The succession of physical and hydrothermo-mechanical treatments has 3 objectives:
1. Concentration of analytical and nutritional values
2. Eliminating the anti-nutritional values without reducing the digestibility of the proteins by preventing Maillard-reactions due to overtoasting.
3. By mechanical treatment causing the rupture of cellwalls to higher oil availability and increase the energetic density.

TECHNOLOGY

The concentration of the analytical values is the result of the right choice of the beans, the better cleaning system, the reduction of the fiber to max 4% and the drying to a level of 9.5 % of humidity.

The hydro-thermomechanical treatment: a toasting followed by flaking and expansion makes from Forta a unique raw material.

Forta has:

More energy by improving the physical and biological availability of the oil and by concentrating the crude oil to max 22 %

More protein (until 38.5%)

Its proteins and aminoacids have optimal digestibility due to PDI (protein digestibility index) near to 20% and a spectacular reduction of the anti-nutritional factors (ANF)

PDI, urease activity, ANF factors and oil availability are four essential tests for judging the quality and regularity of the total treatment.

STORAGE – CONSERVATION

Forta has a perfect behaviour for storage and dosing due to the low humidity. Forta can be stored for months in silos without alteration of its properties.

FORMULATION

Danis R&D created Forta as a raw material for high density of protein and energy animal feed production.

DANIS
ALPREN BELGIQUE
TRADE ALLIANCE

FORTA

FORTA®
A concentrate of soybeans

ENERGY		
PIG		
NET ENERGY	Kcal/Kg	3218
DIGESTIBLE ENERGY	Kcal/Kg	4597
POULTRY		
POULTRY MET. ENERGY	Kcal/Kg	3705
EGG LAYER MET. ENERGY	Kcal/Kg	3980
BROILER MEn. ENERGY	Kcal/Kg	3240
TURKEYS < 15 w	Kcal/kg	3288
TURKEYS > 15 w	Kcal/kg	3462
PROTEIN		
RAW PROTEINS	%	Up to 38.5
PDI PROTEIN DISPERS. INDEX	%	18-22
AMINO ACID		
LYSINE	g/Kg	23.4
METHIONINE	g/Kg	5.4
METH.+CYSTINE	g/Kg	11
TRYPTOPHAN	g/Kg	4.9
THREONINE	g/Kg	15
FATTY MATTER		
RAW FATTY MATTER	%	Up to 22.5
OIL AVAILABILITY	%	92
OLEIC ACID C18 :1	g/Kg	45.8
LINOLEIC ACID C18 :2	g/Kg	112.4
LINOLEIC ACID C18 :3	g/Kg	16.7
ANTI-NUTRITIONAL FACTORS		
UREASIC ACTIVITY	mgN/g min	0,10
ANTITRYPSIC ACTIVITY	UTI/g	<5000
ASHES HUMIDITY		
HUMIDITY	%	< 9.5
RAW ASHES	%	5
CELLULOSE	%	<4

RECOMMENDATION

Starter WEANER	-20%
Grower	-20%
PIG Finisher	5 %
BROILER	15%
EGG-LAYING CHICKEN	15%
TURKEY/DUCK	25%

DANEX SAFETY & PERFORMANCE
THE RIGHT DIET FOR YOUNG ANIMALS

* Values are based on CVB-tables. This information is indicative. Only values offered by contract are binding.

ALPREN BELGIQUE
Tél.: +32 4 257 5734
Fax: +32 4 257 6392

DANEX PRODUCTION & ENLEVEMENT
DANIS NV Noordkaai 11
B 8870 IZEGEM
Bureaux: Knijffelingstraat 15
8851 Ardooie
Tél.: +32 51 740 777
Fax: +32 51 746 844

TRADE ALLIANCE
Parc d'activités de Portes de Bretagne
35530 Servon sur Vilaine
Tél.: 00 33 299 046 530
Fax: 00 33 299 046 533

Danis Belgium – European Top Producer of Full Fat Soya Products

RIVERINA

FULL FAT SOYBEAN MEAL

PRODUCT DESCRIPTION

Soybeans are grown in Australia for seed production, for oil extraction and protein meal production. Full fat soybean meal is produced by cooking or roasting the soybeans.
Full fat soybean contains high fat levels and is a good source of all the essential amino acids.
The heating in the cooking is required to destroy the anti-nutritional factor, trypsin inhibitor. If this trypsin inhibitor is not destroyed there will be reduced digestion of protein and growth can suffer.
Care is needed not to prolong the heat treatment or to have the temperature too high, as this can destroy the nutrients in the meal.

DIRECTIONS FOR USE

- Full fat soybean meal can be included in the diets of pigs, poultry, cattle, sheep and horses of all ages.
- With the high fat levels full fat soybean can be used as a source of linoleic acid for layer hen feeds. The level of linoleic acid in the feed will contribute to the egg weight and the grading of the eggs.

SUGGESTED MAXIMUM INCLUSION LEVELS IN TOTAL DIET

SPECIES	INCLUSION RATE
PIGS -	
YOUNG	10%
GROWING	10%
FINISHING	5%
BREEDING	10%
POULTRY -	
BROILER	15%
LAYER	10%
CATTLE	10%
HORSES	10%
SHEEP	10%

LIMITATIONS

- None, if heat-treated properly.
- Its inclusion in ruminant feeds will be limited by the level of total fat in the diet.

TYPICAL NUTRITIONAL ANALYSIS

PROTEIN	%	MIN:	36.00
CALCIUM	%	:	0.20
PHOSPHORUS	%	:	0.50
FAT	%	:	17.00
ME POULTRY	MJ/kg	:	13.70
DE PIG	MJ/kg	:	17.00
ME RUMINANT	MJ/kg	:	14.00
DE HORSE	MJ/kg	:	17.00

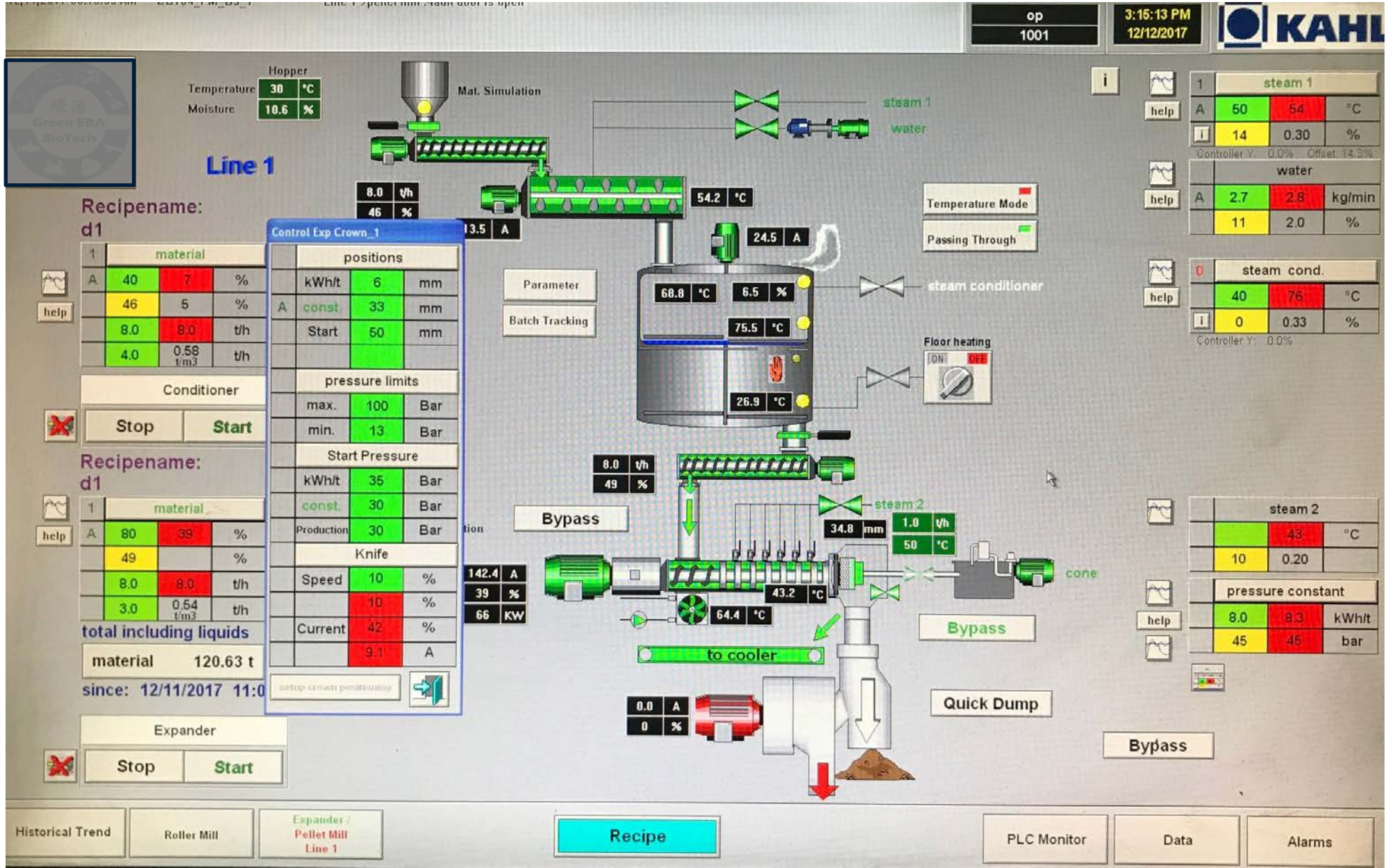
STORAGE

Cool, shaded, dry conditions, away from vermin.

PACK SIZE

20kg polypropylene bag.

Operation Screen操作畫面



Mono components – starch gelatinization for piglets

單味原料 – 小豬料的澱粉糊化

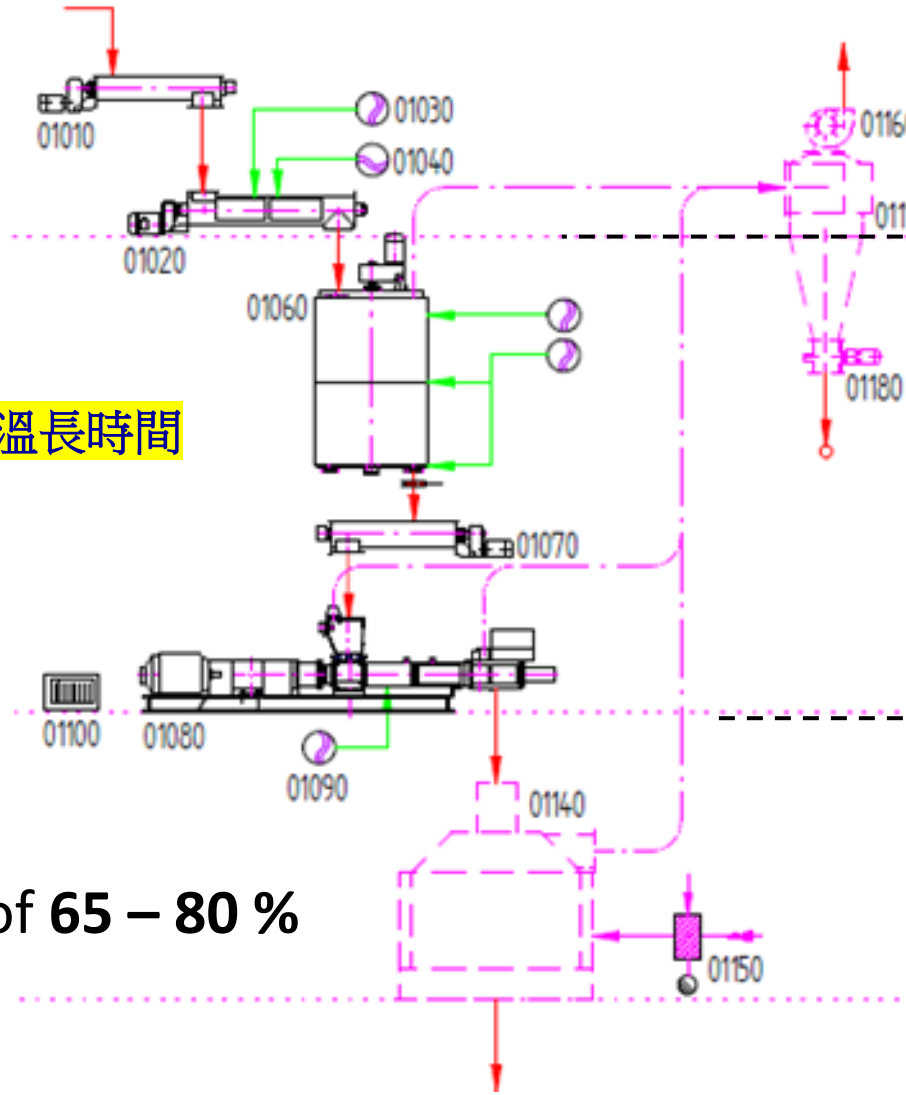
Dosing Screw

Conditioner

Hydrothermal treatment 低溫長時間

Press Screw

Expander



Moisture app. 18 %
Temperature 85° C

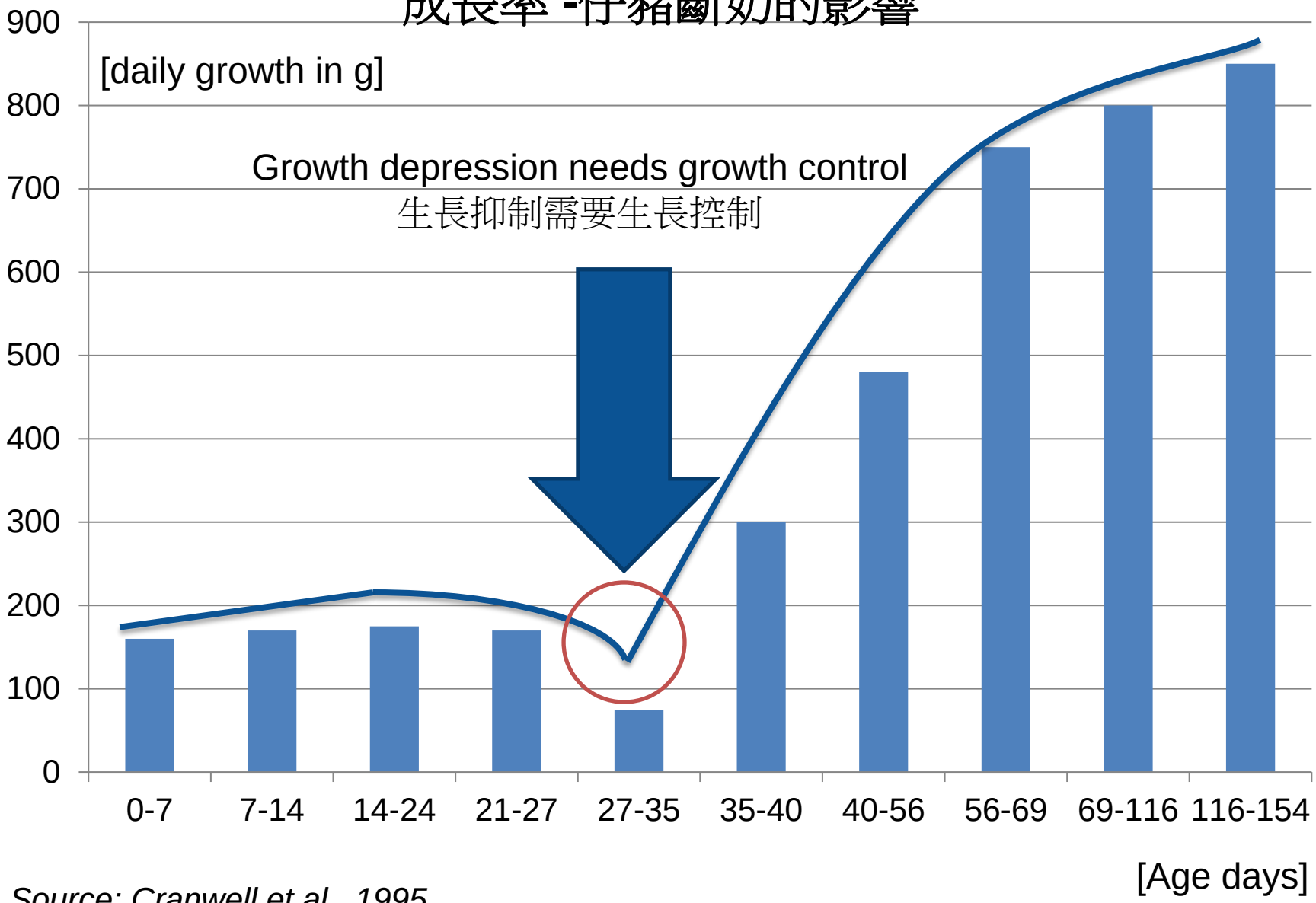
Moisture app. 16 %
Temperature 130° C

→ Starch gelatinization of **65 – 80 %**

澱粉糊化度65-80%

Growth rates – effect of weaning of piglets

成長率 -仔豬斷奶的影響



Source: Cranwell et al., 1995

Piglet – Component Treatment 仔豬 – 原料處理

Components for piglet feed – new trend:

仔豬飼料成分 - 新趨勢

- **Full Fat Soya with low Trypsin and good PDI**

  低胰蛋白酶和好蛋白質溶解度的全脂黃豆粉

  TIA < 3 [胰蛋白酶抑制因子活性]

  PDI 18 – 22 % [蛋白質溶解度指數]

  Urease for Reference: < 0.3 mg / g [尿酶參考值]

- **Soybean extraction meal with reduced allergic abilities (Con-Glycinin) and no Maillard Reaction** 脫脂大豆粉過敏能力（**Con-Glycinin**）降低且無梅納反應。

Influence on piglets 對仔豬的影響

- **Modified “expanded” grain → starch structure** is broken up
  改質「膨化」穀物→澱粉結構被破壞

- **Glucose** is rapidly released and absorbed through the intestinal wall→ better energy supply
  葡萄糖迅速釋放並透過腸壁吸收→供給更好的能源

- **Good water absorption**, homogeneous wet-mix feed
  → liquid feeding
  吸水性好，均質濕混飼料→液體飼餵

Results of latest trials in Kahl (1/2)

糊化度測試結果

Barley 大麥	Energy Input [kWh/t] 比動能	Starch gelatinization [%] 糊化度
	35	57 - 62
	40	64 - 69
	45	69 - 74

Wheat 小麥	Energy Input [kWh/t] 比動能	Starch gelatinization [%] 糊化度
	35	49 - 54
	40	63 - 68
	45	70 - 75

Results of latest trials in Kahl (2/2)

糊化度測試結果

Maize 玉米	Energy Input [kWh/t] 比動能	Starch gelatinization [%] 糊化度
	35	59 - 64
	45	74 - 79
	50	76 - 81

Pig Feed 豬料	Energy Input [kWh/t] 比動能	Starch gelatinization [%] 糊化度
	9	33 - 38
	11	34 - 39
	13	32 - 37

Trends – Full Fat Soya and Pellet Quality for Broilers

趨勢 –肉雞的全脂豆粉和顆粒品質

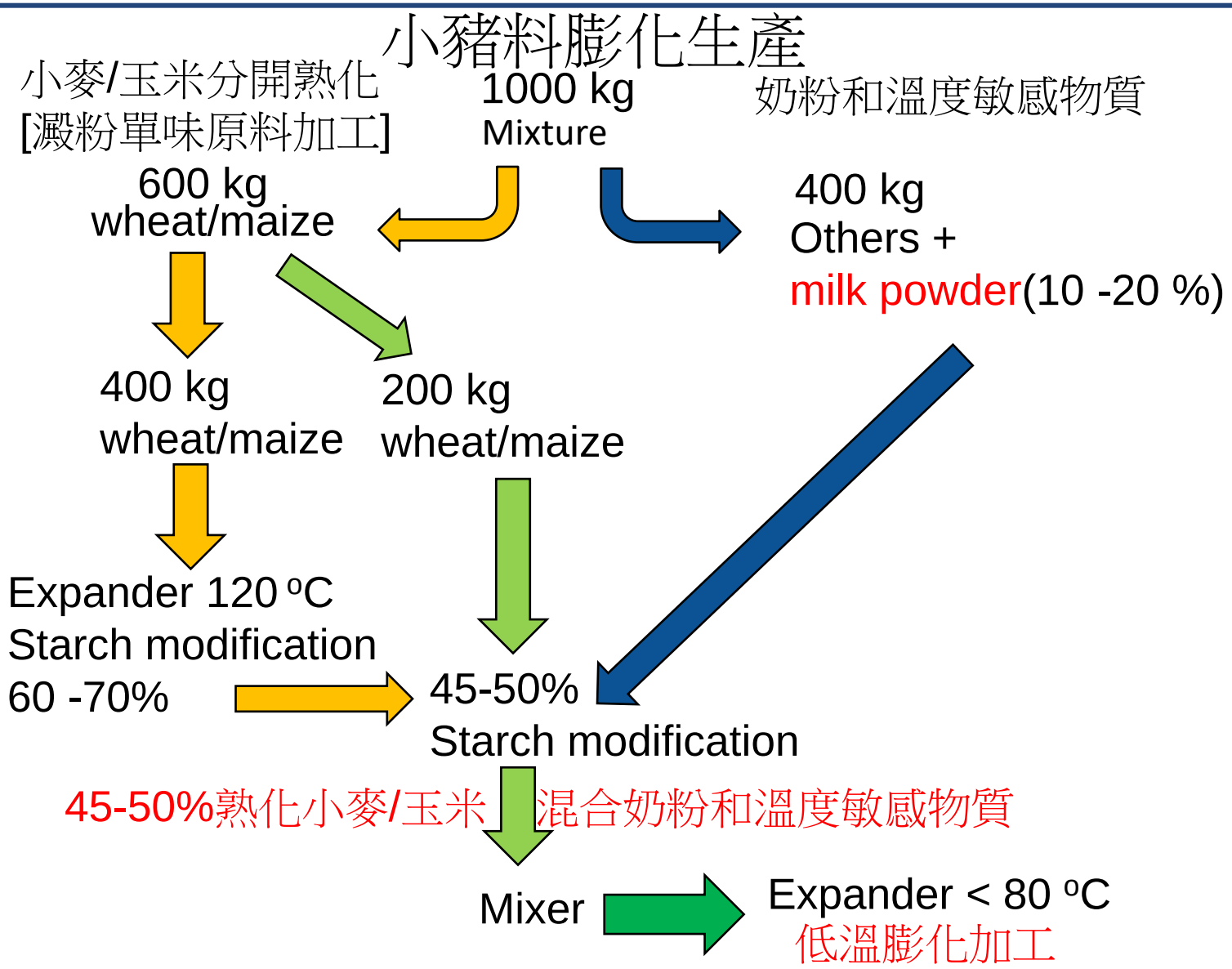
Pellet quality 顆粒品質	Without Expander沒膨化機	With Expander用膨化機
Abrasion 磨損	15 %	7%
PDI 堅牢度	75	90
Throughput 產能	30 t/h	36-37t/h
Animal performance 動物飼料性能		
Metabolism energy 代謝能	2.830 kJ/kg	2.905 kJ/kg
Growth period 成長周期	38 Days	36 Days
Daily gain 日增重	0	+ 10 %

Full Fat Soya – High Quality Protein
全脂豆粉 – 高品質蛋白質

Full fat soya *crown expanded 膨化機	Unit 單位	Before 使用前	After 使用後
Crude protein 粗蛋白	%	38	38
Digestibility of protein 蛋白的消化率	3h/%	80	85 – 90
Trypsin inhibitor 胰蛋白酶抑制因子	mg/g	60	< 2 – 3

Less stress for the digestive system and Improvement of Feed Conversion Rate
減輕消化系統壓力，並提高飼料轉換率

Production of expanded feed for piglet starter



Treatment parameters: Expanded piglet starter with milk powder (exp. crumbles)
處理參數：含奶粉的小豬料(膨化料)

Milk powder Whey powder	Conditioner °C 調質溫度	Expander °C 膨化溫度	kWh/t Expander 膨化機比動能	
high 20 %	60	80	10	
medium 10 %	60	80	10	
low 5 %	65	85	10	

Treatment parameters: Expanded piglet starter with milk powder (pellets)
處理參數：含奶粉的小豬料(打粒料)

Milk powder Whey powder	Conditioner °C 調質溫度	Expander °C 膨化溫度	kWh/t Expander 膨化機比動能	kWh/t Pellet mill 打粒機比動能
high 20 %	55	70	7.5	5
medium 10 %	55	70	7.5	5
low 5 %	60	75	7.5	5

Future Developments 未來發展

- **Component treatment with Expander**
  使用膨化機進行原料處理

- **More inclusion of low costs ingredients, requiring expander technology to maintain pelleting press capacity, pellet quality and nutritional value of feed**
  更多包含低成本原料，需要膨化機技術來維持製粒機產能、顆粒品質和飼料的營養價值

- **More specialized feed applications using Kahl expander technology**
  使用 **Kahl** 膨化機技術做更專業的飼料應用

Thank you for your interest