

利用黃豆蛋白爲養鰻配合飼料可行性之研究—II

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Studies on the Utilization of Soya Protein for Eel Formula Feed—II

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In this trial, the isolated soya protein are dehydrated by isopropyl alcohol before sunshine for improving the quality. The powder are crushed to 60 mesh instead of 40 mesh which was used last year. The soyameal was changed to use the peeled soyameal and enriched with the addition of fishmeal from 10% to 20%. The results are as follows:

1. Food conversion rate: Isolated soya protein(2.87) is similar to that of standard (2.11) and better than that used in last year (3.22-3.35). In the Nov. to the 1st decade of Dec, we find the experimental ponds appeared the lack of D. O. (4.5cc/l). So during this period the food conversion rate of experimental ponds appeared very low levels (Isolated soya protein diet 4.71-9.58; peeled soya meal 8.19).
2. Protein efficiency: The standard diet is 0.88. The isolated soya protein is 0.66. The peeled soya meal is 0.37.
3. Mortality: The standard diet is 28.50%. The isolated soya protein is 31.80%. The peeled soya meal is 39.10%. Experimental ponds are higher than that of standard pond. The main reason is the accidents of aeration machine.
4. The dissolved oxygen to be held at 5.84-6.2 ml/l by aeration is available for better feeding efficiency, especially in experimental ponds.

Key words: Eel feeding trial, Isolated soya protein, Peeled soya meal.

前 言

本計畫獲准時期在68年9月氣候已進入秋季，水溫已略見降低，因此改變過去的做法，以每月作一次中間測定至69年3月底或4月初水溫上升時始作清池。

根據七次中間測定及平時觀察，本計畫進行尚稱正常順利。雖在初期(10月、11月)所得結果有若干異狀，但經與余分所長廷基洽商並加強池水DO之測定，已知攝餌情況變化原因，故改進池水攪拌打氣後一切已見正常(請參照12月以後的各項測定結果。)

在飼料原料製造方面黃豆單離蛋白之乾燥由直火焙乾改爲利用有機溶劑脫水後日光乾燥，粒度也由40mesh改爲60mesh，由飼料係數蛋白質效果觀之整個飼料的效率已有相當大的改進。另黃豆粉改使用脫皮黃豆粉並增加魚粉添加量(由原來的10%改爲20%)。明年度我們已預備增添噴霧乾燥機，則乾燥法可望更改善，並計畫將黃豆蛋白製成鈉鹽以增加其溶解性。

材 料 及 方 法

材料：本試驗使用三種飼料作為養鰻試驗飼料，分別為標準（比較用）、脫脂黃豆粉、精離黃豆蛋白及脫皮黃豆粉混合魚粉。調製配方如表 1 所示。飼料各微量成分，自各廠商購得，純度為飼料級。

Table 1 The compositions of the artificial diets for eel.

Composition (%)	Standard (control)	Isolated soyabean protein	Defatted soya mea powder(peeled)
White fish meal	70		20
Yeast powder	2	4	4
α -Starch	12	6	
Defatted linen seed meal	15	15	15
Salt	0.5	0.5	
Vitamin mix.	1	1	1
Isolated soyabean protein		56	
Na-glutamate		0.05	0.06
Glycine		0.05	0.06
Defatted soyabean meal (peeled)			48
Bromelein		0.05	0.06
BHT		0.2	0.2
Fish bone powder		10	10

此三種飼料的一般成分經分析如表 2 所示。

Table 2 The common components of artificial diets.

Common component (%)	Standard (control)	Isolated soyabean protein	Defatted soya mea powder (peeled)
Moisture	9.53	11.25	10.88
Crude ash	16.94	11.50	16.14
Crude fat	5.72	1.93	3.31
Crude protein	53.69	53.00	49.38

方法：此試驗利用 600 平方公尺的大型魚池進行試驗、飼育方法，先以市售飼料混合試驗飼料馴解，再逐漸用試驗飼料飼養，本野外試驗由鹿港分所執行。

飼養期間分別測定池中水溫與氣溫變化情形及水中溶氧 (Dissolved oxygen) 變化，水溫及氣溫利用水銀標準溫度計測定之，水中溶氧測定以集水瓶收集測定池水後，以溶氧測定器測定之。

試 驗 結 果

野外試驗中間測定結果如表 3、表 4、表 5、表 6、表 7、表 8、表 9 為清池測定結果。

Table 3 The results of harvest of eel (Sep.-Oct.)

Results	Standard (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Initial quantity (g/tails)	65780/4,190	106,700/3,654	231,000/3,570
Final quantity (g/tails)	2,340/100	4,010/100	8,960/100
Mean weight increased (g)	7.70	10.90	24.81
Diet used (g) *A.	38,500	50,000	50,000
*B.	26,000	39,700	144,400
Mean body weight (g)	23.40	40.10	89.60
Food conversion rate	2.00	2.50	3.06
Protein efficiency	0.93	0.75	0.67

*A. Test eel diet.

*B. Local trade eel diet.

Table 4 The results of harvest of eel (Oct.-Nov.)

Results	Standard (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Initial quantity (g/tails)	2,340/100	4,010/100	8,960/100
Final quantity (g/tails)	3,180/100	4,260/100	10,460/100
Mean weight increased (g)	8.40	2.50	15.00
Diet used (g) *A.	85,000	87,500	127,500
*B.	18,200	33,000	11,000
Mean body weight (g)	31.80	42.60	104.60
Food conversion rate	3.26	9.58	2.65
Protein efficiency	0.57	0.20	0.77

*A. Test eel diet.

*B. Local trade eel diet.

Table 5 The results of harvest of eel (Nov.-Dec.)

Results	Standard (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Initial quantity (g/tails)	3,180/100	4,260/100	10,460/100
Final quantity (g/tails)	4,090/100	5,220/100	11,050/100
Mean weight increased (g)	9.10	9.60	5.90
Diet used (g)	94,400	110,000	*A. 51,500 *B. 14,500

Mean body weight (g)	40.90	52.20	110.50
Food conversion rate (g)	2.48	3.14	3.73
Protein efficiency	0.75	0.60	0.54

*A. Test eel diet.

*B. Local trade eel diet.

Table 6 The results of harvest of eel (Dec.-Jan.)

Results	Standard (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Initial quantity (g/tails)	4,090/100	5,220/100	11,050/100
Final quantity (g/tails)	4,610/100	5,970/100	11,480/100
Mean weight increased (g)	5.20	7.50	4.30
Diet used (g)	54,200	74,000	40,000
Mean body weight (g)	46.10	59.70	114.80
Food conversion rate	2.49	2.70	2.61
Protein efficiency	0.74	0.70	0.78

Table 7 The results of harvest of eel (Jan.-Feb.)

Results	Standard (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Initial quantity (g/tails)	4,610/100	5,970/100	11,480/100
Final quantity (g/tails)	5,190/100	6,710/100	11,900/100
Mean weight increased (g)	5.80	7.40	4.20
Diet used (g)	59,500	75,000	38,000
Mean body weight (g)	51.90	67.10	119.00
Food conversion rate	2.45	2.77	2.53
Protein efficiency	0.76	0.69	0.81

Table 8 The results of harvest of eel (Feb.-Mar.)

Results	Standard (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Initial quantity (g/tails)	5,190/100	6,710/100	11,900/100
Final quantity (g/tails)	6,140/100	7,760/100	12,130/100
Mean weight increased (g)	9.50	10.50	2.30
Diet used (g)	40,500	47,500	30,500

Mean body weight (g)	61.40	77.60	121.30
Food conversion rate	1.02	1.24	3.71
Protein efficiency	1.83	1.52	0.55

Table 9 The results of harvest of eel (Sep.-Apr.)

Results	Standard (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Initial quantity (g/tails)	65,800/4,190	106,800/3,654	231,400/3,570
Final quantity (g/tails)	287,500/2,996	291,100/2,492	246,700/2,174
Mean weight increased (g)	80.26	87.54	48.66
Diet used (g)	507,800	626,200	580,400
Mean body weight (g)	95.96	116.77	113.48
Food conversion rate	2.11	2.87	5.49
Mortality (%)	28.50	31.80	39.10
Protein efficiency	0.88	0.66	0.37

根據表 3—8 等結果可知：
餌料係數依標準飼料、精離黃豆蛋白、脫皮黃豆粉分別為 1.02—3.26，1.24—9.58，2.53—5.49，蛋白效果分別為 0.57—1.83，0.20—1.52，0.37—0.81 由表 9 知死亡率分別為 28.50，31.80，39.10

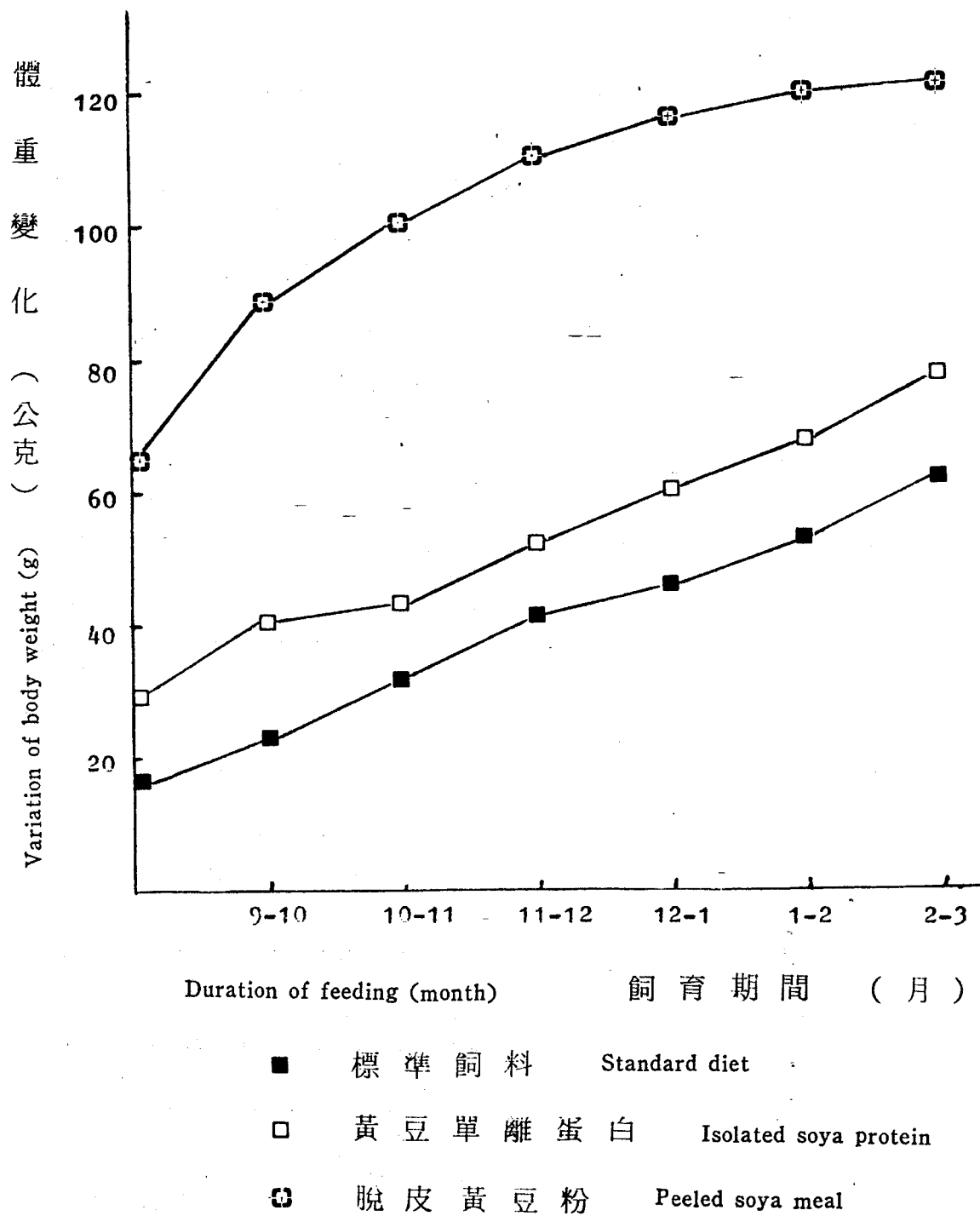
討 論

為便於比較起見，根據以上試驗結果，整理繪製圖 1、圖 2，由圖可以知道精離黃豆蛋白的效果相當良好，脫皮黃豆粉的效果較差，但因價格便宜，添加動物性蛋白質，不失為一良好的蛋白源。
依表 10 觀之，清池後所得單離蛋白飼料之餌料係數為 2.87 與標準飼料為 2.11 相差不大，中間測定雖然在 10 月—11 月為 9.58 但已知其因為池中溶氧不定之故，攝餌情形不良，改進池水攪拌打氣後情形良好。

Table 10. The food conversion rate of eel fed with either white fish meal, isolated soyabean protein, or defatted soya meal.

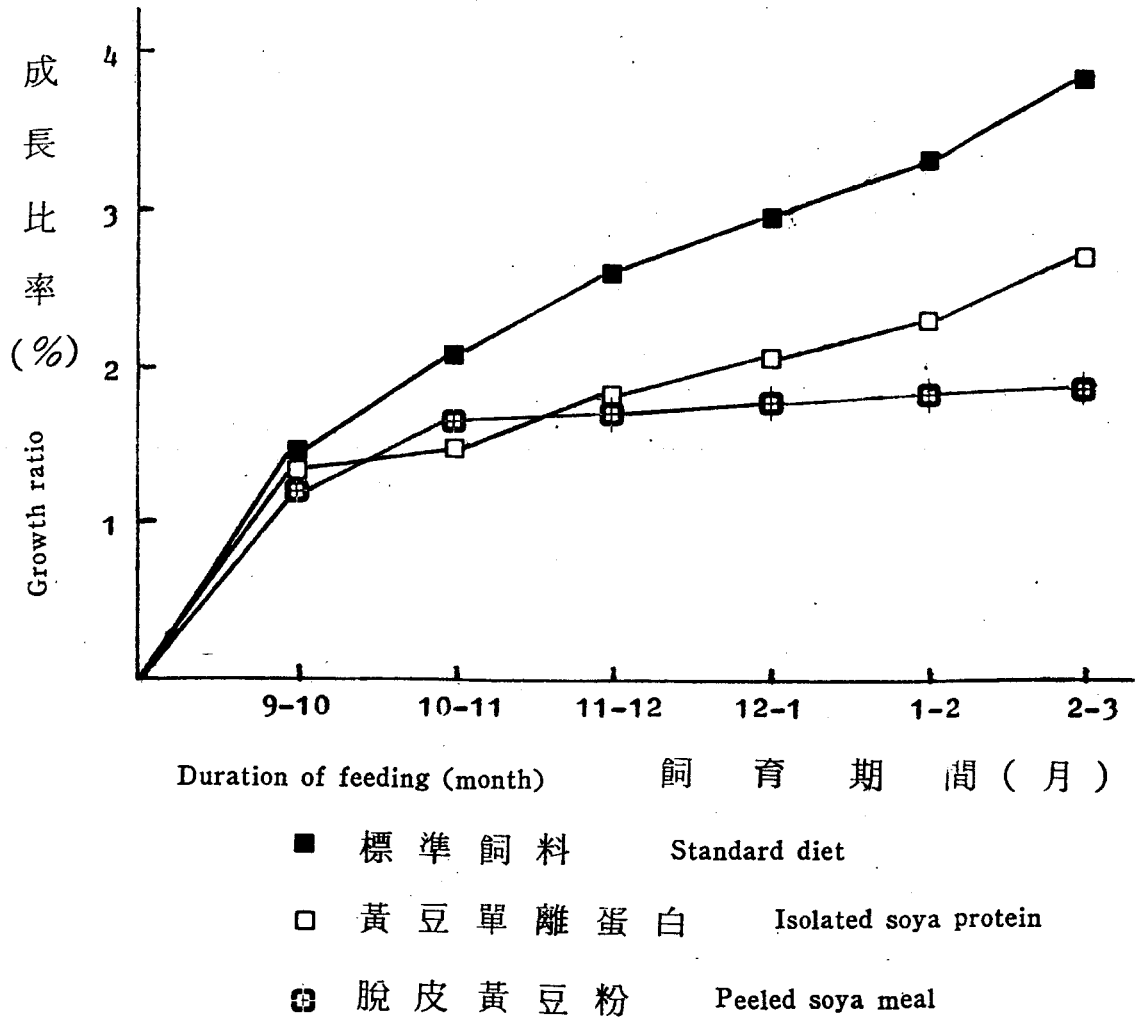
Duration	White fish meal (control)	Isolated soyabean protein	Defatted soya meal powder(peeled)
Sep.-Oct.	2.00(0.93)*	2.50(0.75)	3.06(0.67)
Oct.-Nov.	3.26(0.57)	9.58(0.20)	2.65(0.77)
Nov.-Dec.	2.48(0.75)	3.14(0.60)	3.73(0.54)
Dec.-Jan.	2.49(0.74)	2.70(0.70)	2.61(0.78)
Jan.-Feb.	2.45(0.76)	2.77(0.69)	2.53(0.81)
Feb.-Mar.	1.02(1.83)	1.24(1.52)	3.71(0.55)
Sep.-Apr.	2.11(0.88)	2.87(0.66)	5.49(0.37)

()* is the protein efficiency.



圖一 養鰻人工配合飼料體重變化

Fig. 1. Variation of body weight during artificial eel feeding trial



$$\text{成長比率} = \frac{\text{中間測定時平均體重}}{\text{試驗前體重}}$$

$$\text{Growth ratio} = \frac{\text{Body weight of eel during trial}}{\text{Body weight before trial}}$$

圖二 養鰻人工配合飼料成長比率

Fig. 2. Growth ratio of eel during feeding trial

飼養期間之每次撈捕 100尾作中間測定結果，其餌料係數與四月清池後所得結果相差不大，可以作為養殖期間攝餌情形及鰻體健康狀況之參考（如表10）。

根據江草25°C鰻魚氧氣消費量如下表：

體重(公克)	5	10	20	50	100	150	200	300
消費量cc/hr/尾	0.75	1.20	2.00	3.80	6.20	8.30	10.20	13.50
cc/hr/公斤	150	120	100	76	62	55	51	45

本年度執行計畫期間係在冬天(10月—1月)進行，溫度多在14—22°C，水中溶氧較25°C時略有不同，水溫與溶氧的關係如下：

水溫(°C)	0	5	10	15	20	22	24	25	28	30
溶氧cc/l	10.20	8.90	7.90	7.15	6.50	6.27	6.06	5.95	5.66	5.48

根據本年度實際試驗結果

池中溶氧含量與攝餌情況有密切關係，投餌時(在上午10時)其溶氧在5.5—6.2ml/l攝餌情況良好，故每日投餌前必須注意水溫及溶氧值以為飼料量的參考。(如表11)

Table 11. The variation of temperature during trial (Air temperature °C, measured at 9, a. m.).

	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1st decade	29.6(27.7)	20.8(22.9)	22.5(22.5)	17.6(17.5)	16.2(15.3)	13.3(12.4)	19.9(18.7)
2nd decade	29.4(27.8)	22.0(22.7)	17.8(17.4)	17.1(16.8)	14.0(13.3)	15.7(15.0)	20.9(18.8)
3rd decade	26.6(26.2)	21.7(22.0)	15.5(15.7)	16.8(16.5)	14.3(13.0)	16.8(15.2)	19.5(17.9)

The variation of dissolved oxygen during trial (measured at 10, a. m.).

decade	Dec.	Jan.	Feb.	Mar.	
A. {	1st	5.5	5.8	5.8	5.6
	2nd	5.5	6.0	5.8	5.8
	3rd	5.7	6.0	5.9	5.7
B. {	1st	6.0	6.1	5.9	5.8
	2nd	6.3	6.3	5.9	6.0
	3rd	6.0	6.1	6.1	5.8
C. {	1st	5.8	5.5	6.2	5.7
	2nd	5.8	5.9	6.0	6.1
	3rd	5.6	5.8	6.1	6.0

A. Standard diet

B. Isolated soy meal protein

C. Peeled soy meal

死亡率以脫皮黃豆粉飼料為最高達 39.10%，其次為單離蛋白飼料為31.8%，以標準飼料之死亡率為最低為28.5%，死亡率偏高其因為養殖期間沒經分養之故，否則飼養情形定會更令人滿意。

摘 要

本次試驗，改以異丙醇脫水後，再行日乾，以改善精離黃豆蛋白的品質，粒度也由40篩目(mesh)增至60篩目(mesh)以改善消化率，黃豆粉改用脫皮黃豆粉，並增加魚粉添加量為20%，經試驗結果：

- (1)精離黃豆蛋白之餌料係數為2.87與標準飼料之2.11相差不大，而較去年的3.22—3.35改善甚多。
- (2)死亡率以標準飼料飼育者為 28.50%，以精離黃豆蛋白飼育者為 31.80%，脫皮黃豆粉者為 39.10%。
- (3)充分的打氣維持溶氧在5.50—6.20ml/l對飼育成績良好。

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