Chapter IV

RESULTS

1. Preparation of Dry Brewery Yeast

Dry brewery yeast was prepared over a period of time as shown in Table 22. The concentration of yeast in kilogram per 10 liters of waste yeast before the preparation step was also included. This value was needed in order to check the variation of yeast concentration in the waste yeast solution before preparation step. The total dry yeast product was 88 kilograms. It was evident that there was some loss of yeast during preparation step. The dry brewery yeast obtained was brown in color, mild in odor, and rather bitter in taste.

2. Chemical Analysis of Dry Brewery Yeast

The chemical analysis of dry brewery yeast was shown in Table 23 . The brewery yeast contained very high protein (54-56 per cent) but low in calcium (0.21 per cent). Hence, the yeast could substitute fish meal and soybean meal primarily for protein.

3. Chemical Analysis of Feed Meal

The chemical analysis of the first trial feed meals containing 0, 12.5 and 25% yeast replaced fish meal, was shown in Table 24. The feed meals containing no yeast was commercial feed meals which used as the control diets. The analysis of the second trial feed meals containing 0, 24% yeast replaced soy bean meal was shown in Table 25. The results of feed meal containing brewery yeast replaced fish meal and soybean meal were compared well with the control ration.

Table 22

Data on the preparation of dry brewery yeast

No.	Date	Waste Yeast from Brewery Plant (lit)	Concentration of Waste Yeast before preparation step (kg/10 lit)	Dry Yeast Product	
				kg	kg/10 lit
1	August 16,74	60	0.87	3	0.50
2	August 20,74	75	0.82	3½	0.47
3	September 11,74	78	0.93	6	0.77
4	September 13,74	60	1.01	4½	0.75
5	September 19,74	76	0.95	5	0.67
6	September 21,74	61	0.99	4½	0.75
7	September 30,74	81	1.01	6½	0.81
8	October 3,74	86	1.79	9	1.05
9	October 29,74	59	1.32	6½	1.1
10	November 6,74	85	0.81	6	0.71
11	November 13,74	90	1.54	13	1.44
12	November 21,74	80	1.63	10%	1.31
14	November 24,74	75	1.72	10	1.33
			Total	88	

Table 23

Chemical analysis of dry brewery yeast

	% by wt.
Moisture	6.8 - 7.5
Kjieldahl protein	54 - 56
Lowry protein	38 - 38.5
Nucleic acid	15 - 16
Fat	2.54
Calcium	0.21
Phosphorus	1.05
Ash	3.68
Fiber	5.76

Averaged from two duplicating samples.

Table 24.

Chemical analysis of feed meal containing brewery yeast replaced fish meal at 12.5 and 25%. Values are expressed in percentage.

	Initial Feeding Period			Final Feeding Period		
	Control	12.5% Yeast	25% Yeast	Control	12.5% Yeast	25% Yeast
Moisture	11.52	11.49	11.70	12.33	12.7	12.06
Kjeldahl protein (Nx6.25)	23.57	23.46	23.17	20.08	20.42	19.21
Lowry protein	19.37	17.46	16.62	16.07	14.65	12.89
Nucleic acid	4.20	5.89	6.55	4.01	5.77	6.32
Fat	6.99	5.78	4.84	4.72	4.35	3.66
Calcium	1.11	0.93	0.92	1.01	6.90	0.84
Phosphorus	0.91	0.80	0.71	0.78	0.72	0.68
Ash	6.38	6.34	6.37	6.58	6.61	6.76
Fiber	3.82	3.98	4.01	3.33	3.47	3.88

All data averaged from two duplicating samples.

Table 25

Chemical analysis of feed meal containing brewery yeast replaced say been meal at 24%. Values are expressed in percentage.

	Initial Feeding Period		Final Feeding Period	
	Control	24% Yeast	Control	24% Yeast
Moisture	11.53	11.22	11.34	11.19
Kjeldahl protein (Nx6.25)	23.30	23.62	20.10	20.41
Lowry protein	19.20	16.07	14.72	12.49
Nucleic acid	4.10	7.25	5.38	7.92
Fat	6.70	5.56	5.42	5.36
Calcium	1.13	1.07	1.10	0.93
Phosphorus	0.93	0.80	0.72	0.60
Ash	6.39	6.22	5.17	5.32
Fiber	3.97	4.05	3.21	3.41

All data averaged from two duplicating samples.

4. Amino Acid Composition

The amino acid composition of brewery yeast, control feed meal, and meals containing yeast replaced fish meal and soybean meal was shown in Table 26. Only feed meals used in the initial feeding period were analyzed for amino acid composition as they were more important than feed meals usedin the final feeding period. The brewery yeast used in this study contained high lysine and low methionine, i,e., 9.02 and 0.81 grams per 16 grams nitrogen respectively. Actually, lysine and methionine are very important to quantity because the two amino acids are often related to good growth of broilers (Bender, 1958). Feed meal containing yeast replaced fish meal at 12.5% gave the lowest lysine (8.55 g. per 16 g. nitrogen). Feed meal replace fish meal at 25% showed concentration of lysine closes to the control meal (11.18 and 12.18 g. per 16 g. nitrogen respectively). Concerning methionine, yeast replaced 12.5 and 25% fish meal showed similar concentration of the amino acid compared with the control meal (1.11, 1.09, and 1.07 g. per 16 g. nitrogen correspodingly). The concentration of methionine in the meal containing yeast replaced 24% soybean meal was the highest among the meals analyzed (1.57 g. per 16 g. nitrogen). With respect to the concentrations of both lysine and methionine, feed meal containing yeast replaced fish meal at 25% appeared to be comparable to the control meal.

5. Feeding Trials with Broilers

The data of feeding trials were recorded at the first day, after the fifth and eighth weeks of feeding. Reason for this is the data of

Table 26

Amino acid composition of brewery yeast, control feed meal, feed meal replaced fish meal with yeast 12.5 and 25% and feed meal replaced soy bean meal with yeast at 24%. Values are expressed in grams per 16 grams of nitrogen.

Amino Acids	Brewery yeast	Control meal	Replaced Fish Meal 12.5%	Replaced Fish Meal 25%	Replaced soy bean 24%
Lysine	9.02	12.18	8.55	11.18	11.12
Methionine	0.81	1.07	1.11	1.09	1.57
Threonine	3.20	3.80	3.27	2.69	2.56
Valine	4.27	5.50	4.58	4.11	3.86
Isolencine	2.84	3.02	2.76	1.94	2.60
Leucine	5.34	7.04	2.73	5.90	5.19
Phenylalamine	2.92	2.90	2.59	3.23	3.19
Tryptophan*	-	-	-	-	-
Alanine	5.14	6.01	3.84	3.69	4.67
Arginine	4.02	6.59	3.28	4.14	3.91
Aspartic acid	9.18	7.64	7.31	7.69	7.57
½ Cystine	0.51	0.95	0.19	0.52	0.62
Glutamic acid	6.20	15.86	12.37	12.31	11.20
Glycine	3.14	5.38	4.07	3.21	3.97
Histidine	7.12	4.95	3.10	2.99	4.90
Proline	1.61	0.40	3.25	2.76	2.79
Serine	3.02	4.89	3.48	3.19	2.15
Tyrosine	1.70	1.57	2.86	2.01	1.54

All feed meals analyzed were used in the initial feeding period

* Destroyed daring hydrolysis of protein with hydrochloric acid.

feeding trials after the fifth and eight weeks are much more important than other periods of growth.

For the first feeding trial with feed meal containing brewery yeast replaced fish meal at 12.5 and 25%, the number of alive broilers were shown in Table 27. From this table, it appeared that broilers in each group died mostly during the first five weeks, i.e., 4 birds in control group, 8 birds in 12.5% yeast group, and 5 birds in 25% yeast group. A few broilers died in the following week. At the final week, there were a total of 6 dead birds in control group, 10 dead birds in 12.5% yeast group and 6 dead birds in 25% yeast group.

It appeared that all broilers growed normally. No abnormal characteristics were observed. The broilers had beautiful skin and feather (Figs 6 to 8).

Feed consumption, body weight and protein efficiency of feed meal containing brewery yeast replaced fish meal at 12.5% and 25% were shown in Table 28. There was no significant difference in amount of feed used per week among the three groups. Total feed used at the end of the eight week by broilers of control group, 12.5% yeast group, and 25% yeast group were 4.13, 4.10 and 4.11 kg. per bird respectively. The body weight of broilers fed with control feed meal was a little higher than that of broilers fed with feed meal containing brewery yeast replaced fish meal. The body weight of broiler of 12.5% yeast group was heavier than that of 25% yeast group at the final week. The final body weight of broiler of 12.5% and 25% yeast groups were 1.75 and 1.73 kg.per bird respectively. These values were lighter than that of broiler of control group (1.77 kg/bird). Growth rate of broilers of the three groups were shown in Fig 9 . Growth rate increased slowly during the first five weeks but increased rapidly during the fifth

Table 27

The number of alive broilers fed with feed meal containing brewery yeast replaced fish meal at 12.5 and 25%.

Weeks of	Control		12.5% Yeast		25% Yeast		Total		
Feeding	Gr A	Gr B	Gr C	Gr D	Gr E	Gr F	(A+B)	(C+D)	(E+F)
1 (day)	102	101	102	101	102	102	203	203	204
5	100	99	97	98	100	99	199	195	199
8	99	98	97	96	99	99	197	193	198

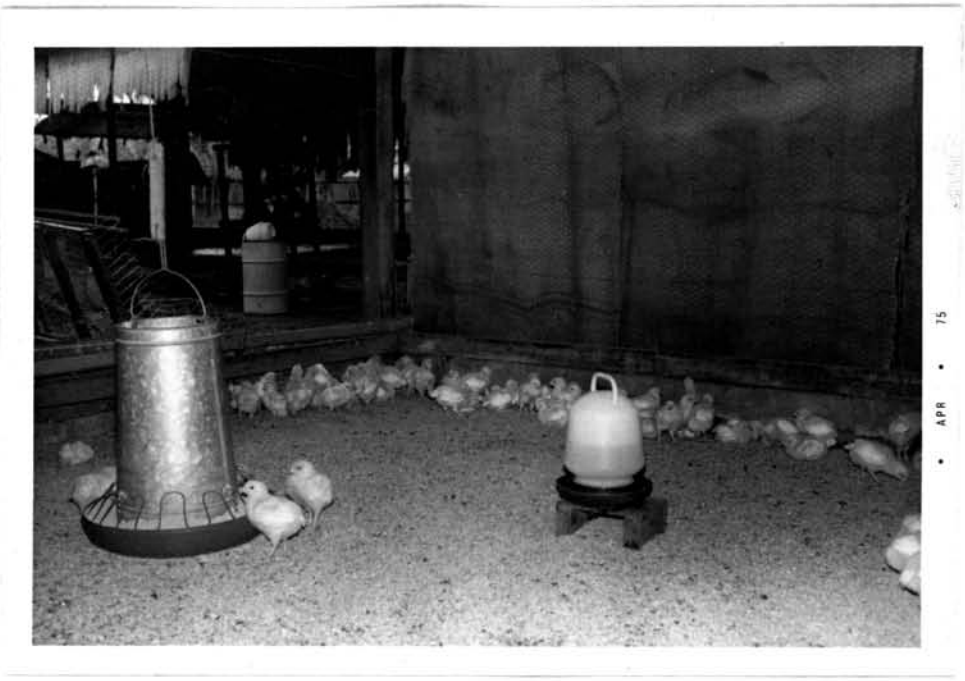


Fig. 6 In the first week, broilers were given feed meal containing brewery yeast replaced fish meal at 12.5%.

Fig.7 Six-week old broilers fed with feed meal containing brewery yeast replaced fish meal at 12.5%.

Fig. 8 Six-week old broilers fed with feed meal containing brewery yeast replaced fish meal at 25%.

Table 28

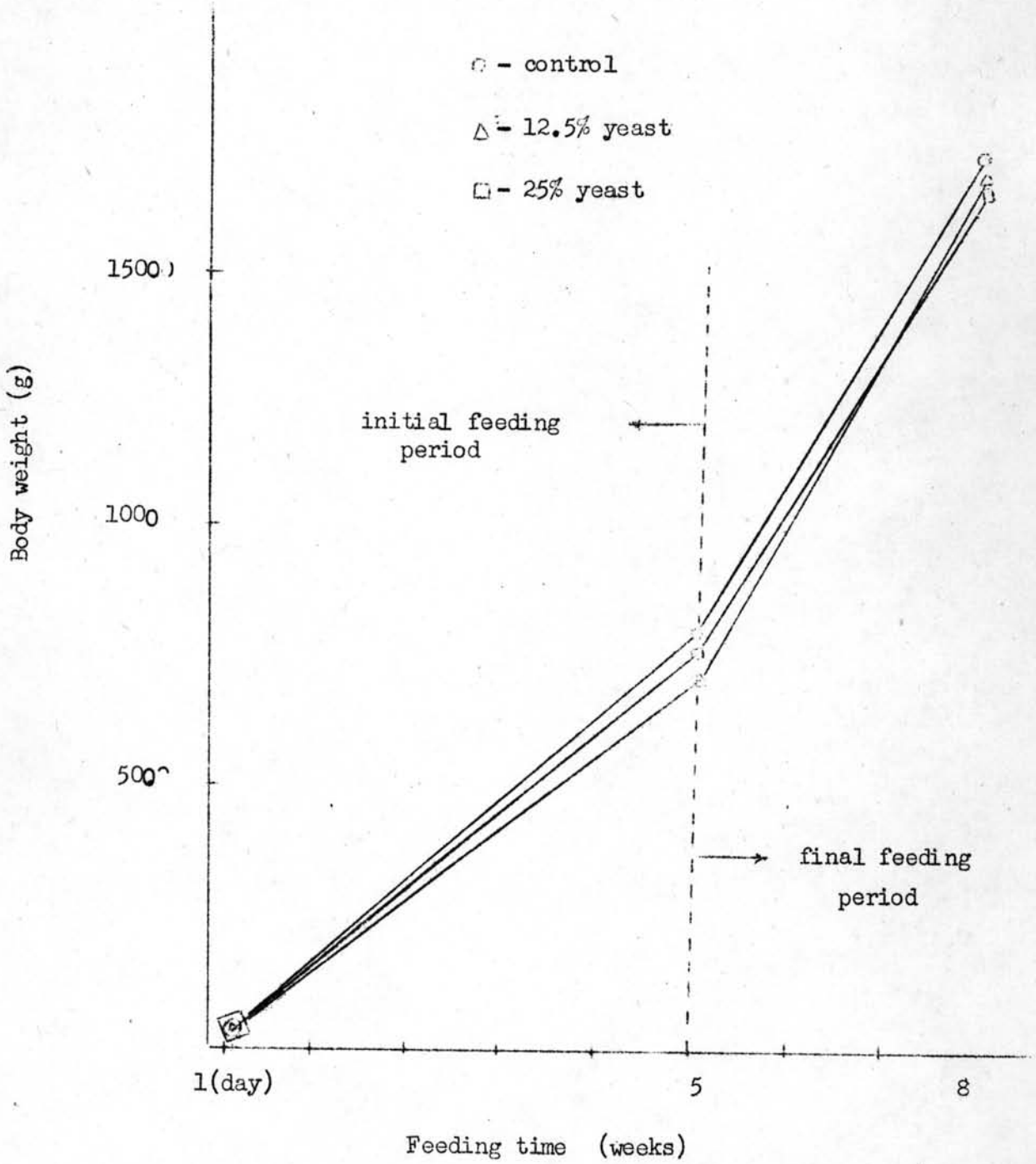
Feed consumption, broiler's body weight and protein efficiency of feed meal containing yeast replaced fish meal at 12.5 and 25%.

Weeks of Feeding	Control		12.5%Yeast		25% Yeast		Average		
	Gr A	Gr B	Gr C	Gr D	Gr E	Gr F	Control	12.5% Yeast	25% Yeast
1 (day):									
body wt (g)	41.18	41.39	41.76	40.4	41.76	42.16	41.28	41.08	41.96
5									
total feed used(g)	1631.0	1651.5	1691.8	1603.1	1686.0	1681.8	1641.2	1649.2	1784.4
body wt (g)	896.0	910.1	896.9	877.6	888.0	902.0	904.0	887.2	894.97
overall protein									
efficiency	1.81	1.81	1.88	1.82	1.89	1.86	1.81	1.85	1.88
8									
total feed used(g)	4118.2	4109.1	4192.8	4016.7	4076.0	4134.3	4134.5	4105.2	4115.2
body wt (g)	1756.6	1780.0	1760.0	1742.7	1725.3	1730.0	1768.0	1751.3	1727.8
overall protein									
efficiency	2.34	2.33	2.38	2.30	2.37	2.39	2.34	2.34	2.38

All data averaged from nnmber of alive broilers.

Overall Protein Efficiency = total feed used (g) /body weight (g)

Fig 9 Body weight of broiler fed with feed meal containing brewery yeast replaced fish meal at 12.5 and 25 %



and eight weeks. These appeared no differences in growth rate of all broilers at initial feeding period. At the final feeding period, growth rate of broiler of 12.5% yeast group increased slower than that of control group and 25% yeast group.

The overall protein efficiency, determined from the total feed consumption devided by the body weight, was calculated and also shown in Table 28 . The protein efficiency of all feed meals increased as feeding time increased. The protein efficiency of the control feed meal was lower than that of feed meal containing 12.5 and 25% yeast replaced fish meal during the initial feeding period. At the eighth week, the overall protein efficiency of control feed meal was 2.34 similar to that of 12.5% yeast group. The overall protein feed meal was 2.34 similar to that of 12.5% yeast group. The overall protein efficiency of feed meal of 25% yeast group was 2.38.

In the second feeding trial with feed meal containing brewery yeast replaced soy bean meal at 24%, the number of alive broilers was shown in Table 29 . The control group was duplicated containing a total of 204 birds and 4 birds died during feeding. Only one bird of 24% yeast group containing 102 birds died during feeding.

All broilers in each group described above showed activity similar to each other. The broilers had beautiful skin and feather (Figs. 10).

Table 30 showed feed consumption, broiler body weight and protein efficiency of feed meals containing yeast replaced soybean meal and control ration. The average feed consumption as well as the body weight of the control group were less than that of 24% yeast group after the fifth and eighth weeks. Total feed consumption at the final week of control group 24% yeast groups were 3.68 and 3.75 kg. per bird. The final body weight

Table 29

The number of alive broilers fed with feed meal containing brewery yeast replaced soy bean meal at 24%.

Week of Feeding	Control			24% Yeast
	Gr.A	Gr.B	Average	Gr.C
1 (day)	102	102	102	102
5	101	100	100.5	102
8	100	100	100	101

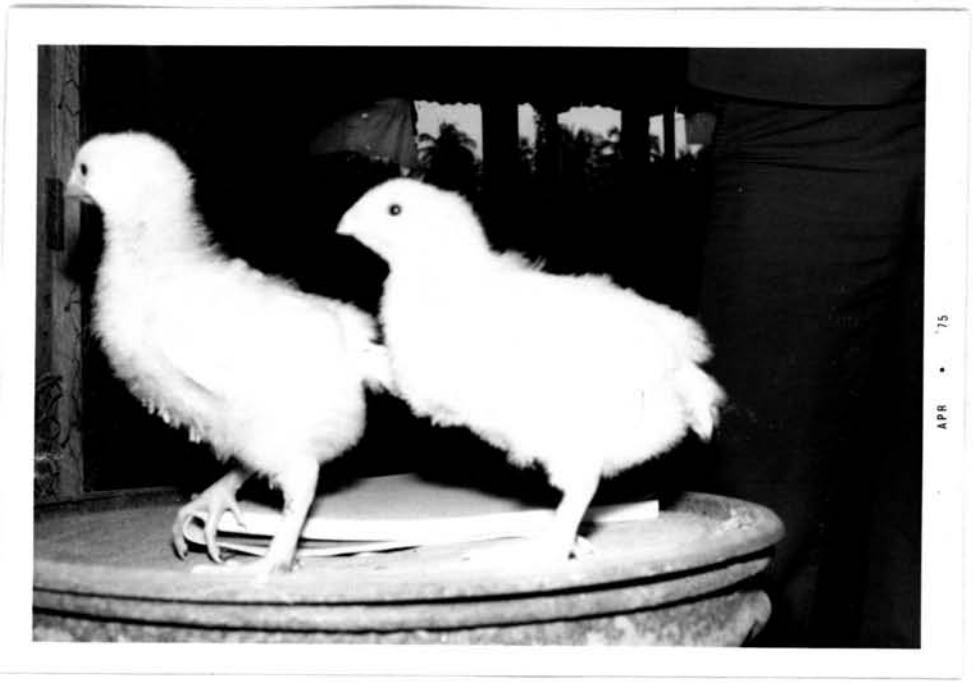


Fig. 10 Comparison of ten-day old broilers fed with feed meal containing brewery yeast replaced soybean meal at 24% and with control ration feed meal.

Table 30

Feed consumption, broiler's body weight, and protein efficiency of feed meal containing brewery yeast replaced say bean meal at 24%

Weeks of Feeding	Control			24% Yeast
	Gr.A	Gr.B	Average	Gr.C
1 (Day)				
body wt. (g)	40.98	41.57	41.27	41.54
5				
total feed used (g)	1571.29	1639.0	1605.12	1636.27
body wt. (g)	842.6	862.0	852.3	888.2
overall protein efficiency	1.86	1.90	1.88	1.84
8				
total feed used (g)	3535.0	3815.0	3675.0	3752.48
body wt. (g)	1576.0	1644.0	1610.0	1675.0
overall protein efficiency	2.24	2.32	2.28	2.24

All data averaged from number of alive broilers.

Overall protein efficiency = total feed used (g)/body weight (g)

of control and 24% yeast group was very close, i.e., 1.61 and 1.68 kg. Growth rate of these broilers was shown in Fig.11 . The growth rate characteristic was similar to that of broilers in the first feeding trial.

Overall protein efficiency of all feed meals was also in Table 30. It appeared that overall protein efficiency of 24% yeast group was slightly lower than that of the other group during both the initial and final feeding periods. The overall protein efficiency at the end of the feeding of control and 24% yeast groups were 2.28 and 2.24.

In summary, number of dead broilers and growth rate of broilers fed with feed meal containing brewery yeast replaced fish meal and soy bean meal were comparable with those of broilers fed with control ration feed meal. The final body weight of broiler in the first and second feeding trials were about 1.7 and 1.6 kg. per bird respectively. The total feed consumption for the first feeding trial with feed meal containing yeast replaced fish meal was about 4.1 kg. per bird. The total feed consumption for the second feeding trial with feed meal containing yeast replaced soy bean meal was about 3.7 kg. per bird. The overall protein efficiency of control feed meal and the one containing 12.5% yeast replaced fish meal were close to each other, and both of them were a little lower than the overall protein efficiency of feed meal containing 25% yeast replaced fish meal. The overall protein efficiency of feed meal containing 24% yeast replaced soybean was slightly lower than that of the control ration. The summary was in Table 31.

Data of broilers' activity, behaviour, and characteristics of growth observed were compared well among all groups in the feeding trials. There appeared no differences in growth characteristics of broilers. All birds showed beautiful feather and skin, and evidenced no abnormal characteristics. They accepted the feed meal containing yeast as well as the control rations.

Fig 11 Body weight of broiler fed with feed meal containing brewery yeast replaced say bean meal at 24%

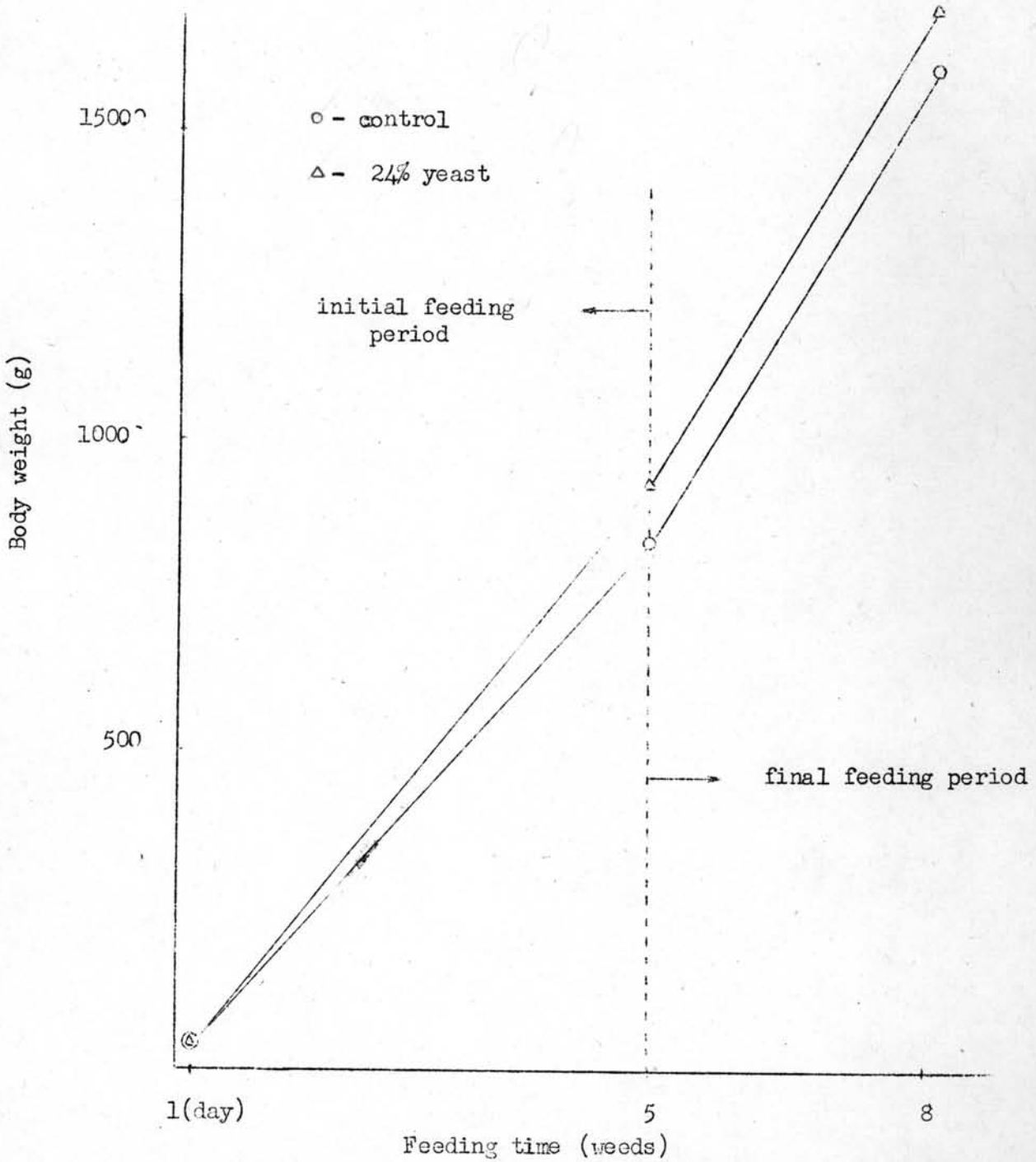


Table 31

Summary of Results of Feeding trials with broilers

	The 1st Feeding Trial			The 2d Feeding Trial	
	% brewery yeast used to replace fish meal			% brewery yeast used to replace soybean meal	
	0	12.5	25	0	24
No. of birds at 1st day	205	203	204	204	102
No. of birds at 56th day	197	193	198	200	101
% Mortality	3.9	4.9	2.9	1.9	1.0
Average feed used (g)	4134.5	4105.2	4115.2	3675.0	3752.5
Average body wt. (g)	1768.0	1751.3	1728.8	1610.0	1675.0
Overall protein efficiency	2.34	2.34	2.38	2.28	2.24