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Effects of Moisture on the Nutritive Value
of Fermented Soybeans for Chick Growth

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It is widely recognized that the most important factor in growth of a fermenting organism is the moisture or relative humidity (RH) surrounding a natural substrate. Mold spores have different minimum water requirements at different temperatures and the presence or absence of nutrients also affects water requirements for growth. Hence, three experiments were designed to investigate the influence of moisture content on the nutritive value of the fermented preparations for chick growth.

Cultures were grown on soybeans at 23%, 29% and 37% moisture for 6, 4 and 3 days, respectively. Experimental diets were formulated together with the uninoculated control soybeans on an isonitrogenous (15% protein) and an isocaloric (3093 Kcal/kg) basis. The experiments were also set up to study whether or not the effect of a bacterial contamination to cultures was favorable for the growth of chicks. The average body weights and feed efficiency data at 4 weeks of age for the three feeding trials are summarized in Tables 1 and 2.

The growth data show that the alteration of moisture and incubation period for the cultured soybeans did not affect the results consistently. The higher water content during fermentation did not enhance the ultimate biological value of soy-proteins. In terms of culture effects, a significant improvement was obtained in experiment 1 where 24 *A. oryzae* and 41 *A. sydowi* were used, whereas no beneficial effects were observed in experiments 2 and 3. It is interesting to note that the growth response was somewhat superior for the chicks fed bacterially contaminated cultures. In general, an improvement in feed efficiency as the level of moisture was increased was noted. Cultured soybeans replacing the control soybeans improved feed utilization.

The data for amino acid analyses (Table 3) show some degree of consistency for the various cultured soybeans as related to their growth promoting effects. Where consistent positive growth responses were obtained, as in experiment 1, the cultured soybeans were higher in almost every essential amino acid. On the other hand, the data for the cultured soybeans used in experiments 2 and 3 indicate somewhat less amino acid content than the controls and, as a result, no positive responses were obtained.

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In summary, no noticeable changes in nutritive value of cultured soybeans due to the alteration of moisture content were found. One of the virtues, if any, of the cultured soybeans prepared with higher moisture is that they seem to have somewhat improved feed efficiency. The data on the amino acid profiles of the cultured soybeans suggest that most of the responses were due to improved protein nutrition.

Table 1. Effect of Moisture of Cultured Soybeans on 4-week Chick Weights

Moisture	<u>Experiment 1</u>			
	Control	24 A. oryzae ¹	24 A. oryzae ²	41 A. sydowi
Low (23%)	456.4	491.3*	464.3	486.1*
Medium (29%)	--	483.0*	493.3*	468.4
High (37%)	--	489.2*	488.5*	503.5**
\bar{X}	456.4	487.8*	482.0*	486.0*

Moisture	<u>Experiment 2</u>				
	Control	4 A. clavatus ¹	4 A. clavatus ²	33 A. sydowi 242 ¹	33 A. sydowi 242 ²
Low (23%)	511.6	525.9	508.1	519.9	501.2
Medium (29%)	--	518.1	490.5	531.7	501.5
High (37%)	--	512.7	492.7	527.2	504.8
\bar{X}	511.6	518.9	497.1	526.3	502.5

Moisture	<u>Experiment 3</u>				
	Control	7 A. flavus	17 A-14,302	28 A. oryzae	67 A. pulvinus
Low (23%)	470.1	447.1**	442.2**	446.1**	420.8**
Medium (29%)	--	451.9*	471.7	462.1	443.4**
High (37%)	--	440.9**	421.2**	487.3*	409.6**
\bar{X}	470.1	446.6	445.0	465.2	424.6*

¹Bacterially contaminated culture.

²Sterile culture.

*Significant at the 5% level.

**Significant at the 1% level.

Table 2. Effect of Moisture of Cultured Soybeans
on Feed Conversion

		<u>Experiment 1</u>			
		24	24	44	
Moisture	Control	A. oryzae ¹	A. oryzae ²	A. sydowi	
Low (23%)	1.96	1.91	1.97	1.89	
Medium (29%)	--	1.86	1.84	1.92	
High (37%)	--	1.84	1.85	1.80	
\bar{X}	1.96	1.87	1.89	1.87	

		<u>Experiment 2</u>			
		4	4	33	33
Moisture	Control	A. clavatus ¹	A. clavatus ²	A. sydowi ¹	A. sydowi ²
Low (23%)	1.91	1.84	1.86	1.83	1.91
Medium (29%)	--	1.87	1.95	1.82	1.89
High (37%)	--	1.84	1.86	1.84	1.81
\bar{X}	1.91	1.85	1.89	1.83	1.87

		<u>Experiment 3</u>			
		7	17	28	67
Moisture	Control	A. flavus	A-14,302	A. oryzae	A. pulvinus
Low (23%)	1.98	2.01	1.95	2.07	2.19
Medium (29%)	--	1.93	1.91	1.98	1.99
High (37%)	--	2.11	2.03	1.91	2.08
\bar{X}	1.98	2.02	1.96	1.99	2.09

¹Bacterially contaminated culture.

²Sterile culture.

Table 3. Essential Amino Acids in the Cultured Soybeans
(m. moles/g. protein)¹

Amino Acid	Experiment 1			
	Control	24 A. oryzae ²	24 A. oryzae ³	41 A. sydowi
Arginine	0.46	0.52	0.46	0.53
Histidine	0.24	0.25	0.28	0.27
Isoleucine	0.50	0.57	0.57	0.59
Lysine	0.29	0.50	0.50	0.51
Methionine	0.11	0.12	0.12	0.13
Phenylalanine	0.44	0.44	0.44	0.48
Threonine	0.46	0.47	0.49	0.51

Amino Acid	Experiment 2				
	Control	4 A. clavatus ²	4 A. clavatus ³	33 A. sydowi ²	33 A. sydowi ³
Arginine	0.67	0.57	0.56	0.53	0.54
Histidine	0.32	0.26	0.25	0.25	0.24
Isoleucine	0.58	0.49	0.54	0.47	0.52
Lysine	0.67	0.52	0.51	0.48	0.46
Methionine	0.10	0.10	0.11	0.12	0.12
Phenylalanine	0.50	0.42	0.42	0.40	0.44
Threonine	0.56	0.47	0.46	0.46	0.50

Amino Acid	Experiment 3				
	Control	7 A. flavus	17 A. flavus	28 A. oryzae	67 A. pulvinus
Arginine	0.50	0.44	0.46	0.51	0.66
Histidine	0.27	0.24	0.22	0.23	0.31
Isoleucine	0.51	0.53	0.50	0.57	0.50
Lysine	0.58	0.41	0.46	0.46	0.57
Methionine	0.13	0.11	0.14	0.15	0.11
Phenylalanine	0.46	0.50	0.44	0.49	0.55
Threonine	0.47	0.43	0.48	0.55	0.79

¹Measured by Beckman Auto Analyzer.

²Bacterially contaminated culture.

³Sterile culture.