

Replacement of fish meal protein by GoldMehl® FM in practical diets for *Nile tilapia*

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Objective

To test whether GoldMehl® FM can replace fish meal in practical diets for Nile tilapia reared in hapas in earthen ponds.

Materials and Methods

In a previously drained and disinfected earth pond of 1 rai (pond 10, Nam Sai Farm, Tambon Bangrabow, Ban Sang, Prachinburi, Thailand).

15 x 5 m² hapas (1mm mesh) were installed and stocked with

Week	Type of feed	Feeding rate (% bw/day)
1	Powder	10.0
2	Powder	9.0
3	Powder	8.0
4	Powder	8.0
5	Powder + pellet	7.0
6	Pellet	7.0
7	Pellet	6.0
8	Pellet	6.0
9	Pellet	5.0
10	Pellet	5.0
11	Pellet	4.0
12	Pellet	4.0

300 1" Nile tilapia fry of 0.2 g initial body mass (total 4,500 fish). The fish were initially fed on powdered feed with a crude protein content of 30% at a rate of 5-10% body weight per day divided into three feeds.

The amount fed was calculated subsequent to biweekly sampling and fed at a set rate for the whole period. After a period of 4 weeks, small pellets, consisting of the same ingredients as the powdered test diets, were added in increasing amounts until the fish were fed entirely on pellets only (Table 1).

The weaning period took 1 week, five isonitrogenous test diets, in which GoldMehl® FM (supplied by GEPRO) is used to replace 0%, 25%, 50%, 75% and 100% of fish meal, was compared in triplicate to test their effect on growth and health performance of stocked juvenile tilapia (Table 2+3).

Proportion of fish meal to GoldMehl® FM		% GoldMehl® FM in diet	Replicates
GoldMehl® FM	Fish Meal		
0	100	0.0	3
25	75	2.5	3
50	50	5.0	3
75	25	7.5	3
100	0	10.0	3
Total			15

An inclusion rate of 3:7 fish meal: soybean meal was used in supplying protein to the control diet, as this is typical of most commercial tilapia diets.

The total culture period was 12 weeks. Hapa change was carried out after 6 weeks of culture, and the fine-meshed 5m² hapas were all replaced with 10m² 4mm meshed hapas which allow for better water exchange.

Parameters measured		
Total weight of fish per hapa (kg)		Biweekly
Mean weight per fish (g)		Biweekly
Numbers of fish remaining		Biweekly
Quantity of feed given (g)		Calculated as daily ration
Weight gain		Biweekly
Specific growth rate		Biweekly
Feed conversion ratio (g weight gain per g feed)		Biweekly
Feed efficiency rate (g weight gain per g feed)		Biweekly
Protein efficiency ratio (g weight gain per g protein)		Biweekly
Individual length & weights of 100 fish per hapa		4 week intervals
Photographs of 50 fish from each hapa		end of trial
Water quality	DO at 10cm & 50cm (meter)	Twice weekly at 8 am and 3:30 pm
	Temperature (aquatic chip)	Hourly every day
	pH (meter)	Twice weekly at 8 am and 3:30 pm
	Ammonia (Sera test kit)	Twice weekly at 3:30 pm
	Alkalinity (Sera test kit)	Twice weekly at 8 am
	Nitrite (Sera test kit)	Twice weekly at 8 am
	Secchi disk	Twice weekly at 8 am

Diet preparation

All five diets, consisting both of powder and first feeder pellets, were formulated and prepared by Nam Sai Farms Co. Ltd. All five diets were designed to be equal in terms of crude protein (30%) and crude fat (8%). Thanks to Dr. Orapin and Kasetsart University for allowing use of their extruder for producing floating pelleted feed (**Table 3**). Note that lysine was limiting. It was not added to the diets, as it is a powder and it is not possible to impregnate the lysine into the feedstuffs so that consumption is even by all fish.

Results and Discussion

Survival (**Table 4**) was not significantly different between treatments. There was a large difference between replicates suggesting that survival was related to luck rather than the amount of GoldMehl® in the feed. Survival had a large bearing on other parameters, as high mortality leads to reduce density and leads to higher growth rate. Statistically there was an effect of treatment on individual

Table 3: Feed formulation					
Type of feedstuff	0%	25%	50%	75%	100%
Soybean meal (solvent) (kg)	39.00	39.00	39.00	39.00	39.00
Corn (kg)	16.50	17.15	17.90	19.35	20.60
Tuna fish meal (kg)	17.00	12.55	8.50	4.25	0.00
Cassava meal (kg)	8.35	8.20	9.00	8.95	9.00
Fine rice bran (full fat) (kg)	15.10	16.50	16.20	16.30	16.50
Vegetable oil (kg)	2.05	2.10	2.40	2.65	2.90
Dicalcium phosphate (kg)	1.50	1.50	1.50	1.50	1.50
Vitamin premix (kg)	0.50	0.50	0.50	0.50	0.50
GoldMehl® FM (kg)	0.00	2.50	5.00	7.50	10.00
Total (kg)	100.0	100.0	100.0	100.0	100.0
Constituent	0%	25%	50%	75%	100%
Crude protein (%)	30.00	29.99	30.00	30.00	30.00
Fat (%)	8.00	8.01	7.99	8.00	8.02
Crude fibre (%)	3.78	3.87	3.88	3.91	3.95
Ash (%)	7.85	7.18	6.45	5.70	4.96
NFE (%)	40.01	40.64	41.44	42.22	42.97
Calcium (%)	1.79	1.45	1.14	0.82	0.50
Phosphorus (%)	1.09	0.93	0.78	0.62	0.47
Energy (kcal/kg)	2,841	2,856	2,875	2,896	2,916
Histidine (%)	1.12	1.02	0.94	0.85	0.76
Arginine (%)	2.52	2.49	2.46	2.43	2.40
Threonine (%)	1.89	1.82	1.75	1.68	1.61
Valine (%)	2.15	2.17	2.19	2.22	2.24
Methionine (%)	0.66	0.59	0.51	0.44	0.37
Lysine (%)	1.23	1.17	1.11	1.05	0.99
Isoleucine (%)	1.29	1.30	1.31	1.33	1.34
Leucine (%)	2.39	2.39	2.40	2.42	2.43
Phenylalanine (%)	2.16	2.11	2.07	2.03	1.99
Tryptophan (%)	0.39	0.39	0.38	0.37	0.36



Table 4: Survival (%) of Tilapia fed with different amounts of GoldMehl® FM

Treatment	Sampling time (weeks)						
	0	2	4	6	8	10	12
0% GoldMehl®	300	248	217	212	210	195	177
25% GoldMehl®	300	246	199	196	193	183	174
50% GoldMehl®	300	239	171	168	166	158	152
75% GoldMehl®	300	230	168	153	152	137	131
100% GoldMehl®	300	279	234	223	219	212	194

growth (Table 5). Survival affected growth, but in the 75% treatment, survival was lower than in 0%, 25% and 50% GoldMehl® FM treatments. As such, one would expect the fish to grow more, as the density of fish was lower, but in actual fact they grew less. This suggests GoldMehl® FM was reducing growth rate in the 75% and 100% treatments.

Statistically there was no significant difference in total weight of fish (Table 5) per hapa, as there was large difference between reps due to the large difference in survival. However, survival was highest in the 100% GoldMehl® FM treatment and one would expect there to be the highest biomass in this hapa.

Results suggest that as GoldMehl® FM inclusion increased (Table 5), feed consumption decreased, although statistically there was no significant difference. This was due to the large effect of survival.

Growth parameters, including weight gain and specific growth rate show a significant difference between treatments,

75% and 100% GoldMehl® FM being lower.

This is no doubt true, as in the 75% GoldMehl® FM treatment, survival was lowest, but SGR was still lower than treatments 0%, 50% and 75% GoldMehl® FM when it should have been higher due to the reduced density. There was no significant difference between food conversion ratio, (Table 6), feed efficiency rate and protein efficiency rate (data not presented). It appears that survival had little effect on these parameter and they are quite similar for all treatments.

Recommendations

GoldMehl® FM can replace fish meal up to 50% in commercial tilapia diets without having any significant effect on growth and feed efficiency parameters.

Table 5: Growth and Survival of tilapia fed with GoldMehl® FM

Treatment	Size at start (g)	Size at end (g)	No. fish stocked	No. fish remaining	Total Wt. (kg)	Survival (%)	Total Fed (kg)	Mean Weight gain		Mean SGR (% BW/d)	F.E.R.	P.E.R.
								g/day	%/day			
0% GoldMehl® FM	0.29	101.8 ^a	300	177 ^a	17.32 ^a	58.9 ^a	23.5 ^a	1.21 ^a	19.27 ^a	10.72 ^a	0.73 ^a	2.26 ^a
25% GoldMehl® FM	0.29	106.6 ^a	300	174 ^a	18.19 ^a	57.9 ^a	23.1 ^a	1.27 ^a	19.44 ^a	10.76 ^a	0.78 ^a	2.43 ^a
50% GoldMehl® FM	0.29	108.5 ^a	300	152 ^a	16.08 ^a	50.7 ^a	19.7 ^a	1.29 ^a	19.34 ^a	10.73 ^a	0.80 ^a	2.49 ^a
75% GoldMehl® FM	0.29	92.5 ^{ab}	300	131 ^a	12.15 ^a	43.8 ^a	16.2 ^a	1.10 ^{ab}	19.45 ^a	10.59 ^{ab}	0.74 ^a	2.30 ^a
100% GoldMehl® FM	0.29	78.5 ^b	300	194 ^a	15.21 ^a	64.6 ^a	20.2 ^a	0.93 ^b	17.63 ^a	10.14 ^{ab}	0.75 ^a	2.32 ^a
Probability		0.0292		0.5098	0.3036	0.5166	0.2424	0.0296	0.3368	0.0148	0.259	0.245
Pooled SE (+/-)		10.380	44.6146		3.4207	8.7520	4.0132	0.1232	0.8836	0.2589	0.043	0.134

Table 6: Feed conversion ratio (kg feed required per kg increase in weight)

Treatment	Mean time for period (weeks)					
	1	3	5	7	9	11
0% GoldMehl® FM	0.46	0.83	1.13	0.97	1.17	1.37
25% GoldMehl® FM	0.46	0.87	1.13	1.01	1.10	1.28
50% GoldMehl® FM	0.47	0.97	1.17	1.04	1.14	1.25
75% GoldMehl® FM	0.46	1.05	1.24	1.09	1.27	1.35
100% GoldMehl® FM	0.41	1.04	1.21	1.06	1.11	1.34

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