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Progress In Poultry
"THROUGH RESEARCH"

THE USE OF GRAPE POMACE IN A FORCE MOLT FEED

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The purpose of this trial was to determine the feasibility, economics, and side benefits of using grape pomace as a portion of a force molt ration.

Experimental Design

The hens used in this trial were Shaver leghorns that were 70 weeks of age at the time the force molt was initiated. Feed was withheld for 1 week and the hens were then fed each of the test rations for 3 weeks. This comprised the first 4-week period. They were then all fed a high protein (17.4%) conditioning ration for 2 weeks. For the rest of the trial, they were all fed on the same phase feeding program normally followed by the ranch. The length of the trial, from initiating molt, was 40 weeks, starting at 70 and going through 109 weeks of age.

Data collected were daily egg production and mortality, feed consumption for each of the feeds used, and body weights in all but one of the 4-week periods analyzed. Manure moisture was also analyzed from a 3-day sample collected starting the fifth day after the hens were placed on each of the force molt rations. The force molt rations are summarized in Table 1. The plots used contained 16 hens each (2 per 8" cage). Each of the treatments was replicated four times with 64 hens per treatment. With four treatments, the entire test included 256 hens.

In the economic analysis, the basal molt ration was assigned a value of $5.60 per cwt; the grape pomace calculated at $2.50 per cwt; the conditioning ration valued at $7.41 per cwt; and the phase feed lay rations at the actual price paid for each ration. These feed costs were then applied to the pounds of feed consumed for each of the 4-week periods analyzed. The egg income data were based on 45¢ per dozen and fowl value on 20¢ per survivor.

Table 1. Composition of molt rations fed for three weeks following one week of feed withholding

Treatment	Grape Pomace % of ration	Grape Pomace (lbs)	Milo (lbs)	Additives (lbs) Limestone	Dicalcium Phosphate	Salt	Vit. & Min. Pre-mix	Total Mix (lbs)
1	0.0	0.0	50.0	3.28	1.09	0.14	0.27	54.78
2	20.0	10.0	40.0	3.28	1.09	0.14	0.27	54.78
3	40.0	20.0	30.0	3.28	1.09	0.14	0.27	54.78
4	60.0	30.0	20.0	3.28	1.09	0.14	0.27	54.78

1/ The percentage of grape pomace is based on the 50-pound mixture of grape pomace and milo. The additives were then added above the 50 pounds for an actual 54.78-pound total mix.

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Results

The pounds of feed per hen day are shown in part A of Table 2. Though not analyzed statistically for each 4-week period, the 40-week summary showed a statistical difference ($P < .05$), with the hens receiving 60% grape pomace in their molt feed consuming significantly more then the controls.

When feed costs were applied to consumption (part B), there was a trend in period 1 toward greater savings as the amount of grape pomace in the diet increased. In period 2, when more expensive feed was used, this trend was reversed. The net effect, shown in the 40-week summary for part B, was no significant differences in feed cost per hen housed. The benefit from using grape pomace would be a lower cost when going through the molt period. This gain would be cancelled out later by consumption of higher priced feed, but this would occur at a time when the hens were producing eggs to help pay the extra cost.

There were no significant differences in eggs per hen housed (part C) except for period 5 when there was a slight ($P < .05$) advantage for the hens fed 20% grape pomace compared to the controls. In the 40-week summary, there were no significant differences and no apparent trends.

Hen-day production (part D) showed no significant differences, except for period 10. Here, the hens fed 40% grape pomace were at a disadvantage compared to those fed 60%. The 40-week summary of hen-day production showed no significant differences or trends.

In part E--percent mortality-- there were no significant differences. There seemed to be a trend toward higher mortality as the amount of grape pomace in molt feed was increased in the 40-week summary. However, at the 20% grape pomace level there was less mortality than in the controls.

Average body weight (part F) did not seem to be affected by the molt feeds. There was one significant difference ($P < .05$) noted in period 5, with the hens receiving 60% grape pomace being heavier than those receiving 40%. This difference developed after all the hens had been on the same feed for 16 weeks, and probably is not related to the previous treatment. At the end of the trial (period 10) the hens averaged within 0.2 pound of each other for all four treatments.

Egg value in cents per hen housed (part G) was based on a price of 45¢ per dozen. The only significant differences noted here ($P < .05$) were for period 5 in which hens receiving 20% grape pomace had an advantage over the controls and those receiving 40% grape pomace. These differences were directly attributable to the advantage noted in period 5, part C--eggs per hen housed. Egg value per hen housed in the 40-week summary showed no significant differences among treatments and no apparent trends.

Egg values minus feed costs are summarized in part H. Other cost factors, like replacements, would be the same for all treatments and therefore have not been included. These figures were obtained before rounding off the above egg value and feed cost data. Therefore, they do not always agree with a simple subtraction of the figures in this table.

For periods 1 and 2, significant trends were apparent with decreasing loss in period 1 and increasing loss in period 2 as the percent grape pomace was increased. The decreasing loss in period 1 is a reflection of the lower feed cost due to increasing the level of grape pomace. The increasing loss for hens previously fed increasing levels (period 1) of grape pomace in period 2 was due to increased consumption of a more expensive feed. For periods 3 through 10, there were no further significant differences noted for egg value minus feed cost.

The 40-week summary for egg value minus feed cost includes a value for fowl based on survivors at 20¢ each upon completion of the trial. Here there were no significant differences, although there appeared to be a trend toward a lower net income as the amount of grape pomace was increased.

(continued)

Table 2. Production factors and economic analysis

Part	4-Week Period		1	2	3	4	5	6	7	8	9	10	40-Week Summary
A	Lbs Feed Per Hen Day	Control	.165	.201	.288	.259	.255	.257	.273	.259	.269	.240	.249z
		20% Grape	.166	.207	.282	.280	.265	.268	.269	.255	.255	.248	.252yz
		40% Grape	.181	.239	.282	.265	.250	.259	.268	.247	.250	.246	.250yz
		60% Grape	.182	.243	.293	.279	.278	.266	.267	.261	.283	.259	.263y
		Sig 1/	← Not statistically analyzed →										*
B	Feed Cost Per Hen H. ¢	Control	19.2x x	39.1z	53.8	46.3z	45.9yz z	45.9	47.6	45.0	46.9	41.4	$4.31
		20% Grape	17.4y xy	41.4z	53.5	50.3y	47.4y yz	48.1	47.8	44.4	43.8	42.5	4.37
		40% Grape	16.6y y	47.9y	53.8	47.6yz	44.4z z	45.3	46.7	43.0	43.2	42.0	4.31
		60% Grape	13.9z z	47.9y	55.0	50.1y	49.9x y	47.8	47.8	45.8	48.4	43.3	4.50
		Sig	* **	*	NS	*	* **	NS	NS	NS	NS	NS	NS
C	Eggs Per Hen Housed	Control	1.02	3.09	19.61	21.00	20.70z	20.34	18.80	19.73	18.53	17.45	160.28
		20% Grape	0.66	2.56	18.55	22.27	21.98y	20.95	20.03	18.72	17.42	17.95	161.09
		40% Grape	0.88	3.41	19.64	20.73	20.55z	19.95	18.75	18.03	16.70	16.14	154.78
		60% Grape	0.81	2.17	18.91	21.52	21.73yz	21.03	20.12	19.88	18.12	18.56	162.86
		Sig	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS
D	Hen Day Pro-duction %	Control	3.66	11.40	71.54	75.50	73.94	73.20	69.29	72.86	68.28	64.69yz	58.40
		20% Grape	2.34	9.15	66.24	79.52	78.87	74.83	72.47	69.00	65.25	67.34yz	58.35
		40% Grape	3.12	12.17	70.15	74.05	74.33	77.34	60.20	66.56	62.21	60.84z	56.41
		60% Grape	2.95	7.92	68.50	76.84	77.62	75.11	72.20	72.90	67.93	71.43y	59.32
		Sig	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS
E	Mortality %	Control	1.56	1.56	---	---	---	1.56	---	---	---	---	4.69
		20% Grape	---	---	---	---	---	---	---	1.56	1.56	---	3.12
		40% Grape	---	---	---	---	1.56	1.56	---	---	1.56	1.56	6.25
		60% Grape	3.12	---	---	---	---	---	1.56	---	3.12	1.56	9.38
		Sig	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
F	Avg. Body Wt. Lb.	Control	3.4 2/	3.9	4.0	NW 3/	4.2yz	4.2	4.1	4.1	4.1	4.0	
		20% Grape	3.3	3.9	4.0		4.1yz	4.1	4.1	4.1	4.0	4.0	
		40% Grape	3.4	3.9	4.0		4.0z	4.1	4.0	4.0	4.0	4.0	
		60% Grape	3.4	4.1	4.3		4.5y	4.4	4.4	4.3	4.1	4.2	
		Sig	NS	NS	NS		*	NS	NS	NS	NS	NS	
G	Egg Value(¢) Per Hen Housed @ 45¢/Doz	Control	3.8	11.6	73.6	78.8	77.6z	76.3	70.5	74.0	69.5	65.4	$6.01
		20% Grape	2.4	9.6	69.6	83.5	82.4y	78.6	75.1	70.2	65.3	67.3	6.04
		40% Grape	3.3	12.8	73.6	77.8	77.1z	74.8	70.3	67.6	62.6	60.5	5.80
		60% Grape	3.1	8.1	70.9	80.7	81.5yz	78.9	75.5	74.5	68.0	69.6	6.11
		Sig	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS
H	Egg Value(¢) Minus Feed Cost Per Hen Housed	Control	-15.4z z	-27.4y	19.8	32.4	31.8	30.3	22.9	29.0	22.6	24.1	$1.89 4/
		20% Grape	-14.9z z	-31.9yz	15.9	33.2	35.0	30.4	27.3	25.8	21.6	24.8	1.87
		40% Grape	-13.3z yz	-35.2yz	19.9	30.2	32.6	29.6	23.6	24.6	19.4	18.6	1.69
		60% Grape	-10.9y y	-39.8z	15.9	30.6	31.6	31.1	27.7	28.8	19.5	26.4	1.79
		Sig	* **	*	NS	NS	NS	NS	NS	NS	NS	NS	NS

1/ Significant differences. One asterisk denotes 95% and two asterisks 99% confidence limits. 2/ Weights taken at end of 4-week period.

3/ Not weighed. 4/ Survivor value added at 20¢ per hen for the 40-week summaries.

In the above calculations, the feed prices used were $5.60 per cwt for molt feed; $2.50 per cwt for the grape pomace; $7.41 per cwt for the 17.4% protein conditioner used for the first 2 weeks of period 2; and the actual price paid for the remaining phase feed lay rations. When the price of grape pomace was reduced to $1 per cwt and all other feed costs remained the same as above, returns from eggs and fowl minus feed costs were $1.89, $1.88, $1.71, and $1.82 for the 0%, 20%, 40%, and 60% pomace treatments, respectively. These values were not significantly different from one another.

The effect of increasing levels of grape pomace on manure moisture is shown in Table 3. These samples were collected over a 3-day period after the hens had 4 days to become accustomed to their ration. The composite samples were dried at approximately 200°F until constant weights were reached.

Table 3. Percent moisture in droppings from hens fed diets containing different levels of grape pomace (GP)

Ration	% Water 1/
Control: 100% milo + additives	74.5A 2/
20% GP, 80% milo + additives	66.5B
40% GP, 60% milo + additives	71.6AB
60% GP, 40% milo + additives	72.2AB

1/ Moisture content of composite manure samples collected during 5th, 6th, and 7th day of feeding respective rations.
2/ Treatments with different letters are significantly different at the 95% confidence level.

The response trend obtained was somewhat different than one might expect. Numerically, the hens receiving no grape pomace produced the wettest droppings. Those fed 20% grape pomace produced droppings significantly ($P < .05$) drier than the controls.

When pomace levels were increased to 40% and 60%, the droppings were numerically wetter than those from hens fed 20% grape pomace. However, statistically, they were not significantly wetter than those from hens fed 20% grape pomace. They also were not significantly drier than droppings from hens fed no grape pomace. It does appear that hens fed levels of grape pomace higher than 20% may compensate by increasing their water intake.

Summary and Conclusions

The results from this trial indicate that grape pomace can be used as a portion of a force molt ration without affecting overall hen-day feed consumption, feed cost per hen housed, eggs per hen housed, hen-day production, mortality, average body weight, egg value per hen housed, or egg- plus fowl-value minus feed cost. There appears to be a trend toward lower net returns with the higher (40 and 60%) grape pomace levels when grape pomace is valued at $2.50 per cwt. This trend is reduced when grape pomace is valued at $1 per cwt.

When grape pomace was included in the molt ration, there was the benefit of a lower cost to go through a force molt. However, these savings were then lost when the hens were placed on a higher priced ration. This occurred at a time when the hens were returning to production and could help pay the added cost. The overall costs for the full molt-lay cycle were not significantly influenced.

The major side benefit was the lower moisture content of manure from hens fed 20% grape pomace in their molt feed. The lower moisture content can be an aid in fly control. Levels higher than 20% grape pomace would not seem warranted due to the trends (though not significant) toward higher manure moisture content, higher mortality, and lower net return.

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SOURCES OF CALCIUM - EFFECT ON PERFORMANCE

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In recent years, many experiments have been conducted by a number of researchers to study the effect of calcium particle size on egg shell quality and strength. The results of these tests have been variable, but in some cases the incorporation of large calcium particles in the diet has improved egg shell strength.

In several California experiments in which larger particle sizes of calcium were utilized, improvement in egg shell strength was not observed. The reason for these results is unknown, but possibly the hens in our tests were already receiving as much calcium as they could effectively utilize.

Experimental work has suggested also that some calcium sources may be more biologically available to laying hens than others. The authors felt that perhaps differences in availability of calcium may have explained the differing results obtained in experiments where varying particle sizes were utilized. To explore this possibility, an experiment was conducted in 1977 to determine if calcium supplements from different geographic regions would affect performance or egg shell strength.

EXPERIMENTAL

LOCATION: Moreno Ranch, Riverside Co.

HOUSING: California open-type with curtains and hot weather foggers. Three hens per 12 x 18" cage placed back to back.

FEEDING: Ad libitum hand feeding, front feeder.

WATERING: One Hart cup for every 2 cages.

DURATION OF EXPERIMENT: Feb. 2, 1977 to Sept. 13, 1977 (32 weeks). The test started with the 9th week of the 2nd production cycle.

STOCK: 300 - 89-week-old Shaver White Leghorn hens.

EXPERIMENTAL DESIGN: Completely randomized, 5 replicates of 15 hens each, 4 treatments.

MEASUREMENTS: Daily: egg production, feed consumption and mortality. Every 4 weeks: egg weight, candled breakage and shell score. Every 8 weeks: shell thickness, crushing strength and Haugh units.

(continued)

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products not mentioned.

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Table 1. Treatments: Basal diet (93.3%) plus calcium source (6.7%)

	Treatment			
	1	2	3	4
Mineral	Pfizer limestone (California)	Pilot Brand* oyster shell (Southeast U.S.)	Limestone (Colorado)	Calcium Carbonate Co. Limestone (Illinois)
Calcium (%)	36.3	36.8	37.7	38.1
Magnesium (%)	2.0	.29	.33	.12
Zinc (ppm)	35	31	6	6
Manganese (ppm)	99	318	126	41
Iron (ppm)	317	570	248	115
Particle size**				
% Coarse	4.6	25.3	24.4	35.9
% Fine	95.4	74.7	75.6	64.1

* Oyster shells were ground to avoid major differences in particle size.
** Separated with a #20 mesh Fisher Scientific screen.

BASAL DIET COMPOSITION

Corn	41.35%	Dehydrated alfalfa meal	2.49
Milo	23.75	Fish soluble	1.49
Meat and bone meal	7.47	Fish meal	1.00
Soybean oil meal	4.98	Fat	.50
Cottonseed meal	4.98	Pre-mix	.31
Wheat mill run	4.98	Calcium material	6.70

(Calcium = 3.50%)

TABLES OF RESULTS

Table 2. Egg production and egg weight (89 to 121 weeks of age)

	Treatment				
	1	2	3	4	
Trait	Limestone (California)	Oys.shell (Southeast)	Limestone (Colorado)	Limestone (Illinois)	Significant differences*
Hen-day production (%)	68.3	64.6	66.7	68.1	N.S.
Eggs/hen-housed	146	143	144	149	N.S.
Egg wt./hen-housed (kg)	20.6	20.3	20.5	21.0	N.S.
Average egg wt. (g)	64.2	64.4	64.8	63.9	N.S.
Large eggs and above (%)	94.8	95.9	96.3	95.7	N.S.
Mortality (%)	8.5	4.1	7.1	4.3	N.S.
Body wt. gain (%)	7.7a	5.4ab	6.0ab	0.1 b	*

Treatments with different small letters are significantly different ($P < 0.05$).
N.S. = Non-significant differences ($P > 0.05$).
* Significant differences ($P < 0.05$).

Table 3. Feed consumption and conversion

Trait	Treatment 1 Limestone (California)	Treatment 2 Oys. shell (Southeast)	Treatment 3 Limestone (Colorado)	Treatment 4 Limestone (Illinois)	Significant differences
Feed/hen-day (lb)	.244	.236	.240	.237	N.S.
Feed/dozen (lb)	4.29	4.42	4.33	4.17	N.S.
Feed/egg ratio	2.53	2.59	2.53	2.47	N.S.
Protein/hen-day (g)	18.5	17.9	18.2	17.9	N.S.
M.E. Kcal/hen-day	309	299	304	300	N.S.
Calcium/hen-day (g)	3.9	3.8	3.8	3.8	N.S.

N.S. = Non-significant differences ($P > 0.05$).

Table 4. Egg and shell quality

Trait	Treatment 1 Limestone (California)	Treatment 2 Oys. shell (Southeast)	Treatment 3 Limestone (Colorado)	Treatment 4 Limestone (Illinois)	Significant differences
Candled cracks (%)	3.5	5.6	4.5	3.5	N.S.
Shell smoothness*	.50	.55	.58	.54	N.S.
Shell thickness (microns)	361	373	378	366	N.S.
Crushing strength (kg)	3.44	3.44	3.48	3.50	N.S.
Albumen height (mm)	6.8	6.8	6.6	6.5	N.S.
Haugh units	80.5	80.4	79.5	78.8	N.S.

*0 = Smooth shell; 3 = Very rough.
NS = Non-significant differences ($P > 0.05$).

Table 5. Economic results*

Trait	Treatment 1 Limestone (California)	Treatment 2 Oys. shell (Southeast)	Treatment 3 Limestone (Colorado)	Treatment 4 Limestone (Illinois)	Significant differences
Feed cost/dozen	27.9¢	28.7¢	28.2¢	27.1¢	N.S.
Average egg value/dozen	44.7¢	44.8¢	44.8¢	44.8¢	N.S.
Egg income minus feed/ hen-housed	$2.05	$1.94	$2.01	$2.19	N.S.

*Feed was calculated at $6.50/100 lbs.
Eggs were priced at 45¢/dozen for large; 40¢/dozen for medium; and 25¢/dozen for small.
N.S. = Non-significant differences ($P > 0.05$).

Table 6. Shell quality changes by period* (4 weeks)

	Period**							
	3	4	5	6	7	8	9	10
Trait	March 1	March 29	April 26	May 24	June 21	July 19	August 16	September 13
Candled cracks (%)	2.2	3.3	3.2	3.3	5.6	3.3	5.3	8.1
Shell score	.26	.43	.36	.40	.52	.76	.77	.85
Shell thickness (microns)	394	--	381	--	363	--	343	--
Crushing strength (kg)	3.78	--	3.63	--	3.39	--	3.07	--

* All calcium sources combined.
** Periods 1 and 2 include the force molt prior to start of the test.

DISCUSSION

Statistical analyses of over forty measurements failed to show any significant response differences ($P < 0.05$) between calcium sources except for body weight change (Table 2). Even though percentage cracks ranged from 3.5 percent to 5.6 percent, shell thickness from 361 microns to 378 microns (Table 4) and egg income minus feed cost from $1.94 to $2.19 (Table 5), within-treatment variation exceeded that among the various treatments. None of the differences in shell strength measurements approached statistical significance, even at the 10 percent level.

Also of interest is the apparent lack of relationship between any of the shell strength measurements. The least number of candled cracks at point of gathering occurred in the eggs with the thinnest shells (Table 4).

These results suggest that calcium supplements originating from widely different geographic areas do not necessarily vary greatly in their biological availability of calcium as measured by the performance of hens to which the supplements are fed. This is not to say that all calcium sources are alike or of equal value. In the trial reported here, significant differences in responses to the four supplements tested may have resulted if the ration had been formulated to provide for marginal or sub-marginal intakes of calcium. Also, a larger sample size of hens would have increased the possibility of identifying real differences among treatments, even though differences were small and the responses within treatments were somewhat variable.

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