STUDIES ON THE WHOLESOMENESS OF A COMPLEX SODIUM ALUMINUM ACID PHOSPHATE, A NEW BAKING COMPOUND

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J. A. Hoffert

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STUDIES ON THE WHOLESOMENESS OF A COMPLEX SODIUM ALUMINUM ACID PHOSPHATE, A NEW BAKING COMPOUND

By
HERBERT E. KASOFF

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INTRODUCTION

In general, three types of compounds are used for the purpose of liberating carbon dioxide from baking soda for lightening or "leavening" baked products. These compounds include: acids (e.g.tartaric acid), acid salts (e.g.calcium acid phosphate and potassium acid tartrate) and non-acid salts which act as very weak acids (e.g.sodium aluminum sulphate). Typical reactions of these compounds with baking soda are:

$$H_2C_2H_4O_6 + 2NaHCO_3 \longrightarrow Na_2C_4H_4O_6 \; 2CO_2 + 2H_2O$$

Tartaric Acid

$$KHC_4H_4O_6 + NaHCO_3 \longrightarrow KNaC_4H_4O_6 + CO_2 + H_2O$$

Potassium Acid Tartrate "Cream of Tartar"

$$3CaH_4(PO_4)_2 + 8NaHCO_3 \longrightarrow Ca_3(PO_4)_2 + 4Na_2HPO_4 + 8CO_2$$

Calcium Acid Phosphate

$$2NaAl(SO_4)_2 + 6NaHCO_3 \longrightarrow 2Al(OH)_3 + 4Na_2SO_4 + 6CO_2$$

Sodium Aluminum Sulphate "Alum"

Besides the acid salts of orthophosphoric acid, those of pyrophosphoric acid have been used extensively in commercial baking.

The latter were at one time brought under the careful scrutiny of the Food and Drug Administration because of the supposed harmful effects of pyrophosphates when injected into small experimental animals (1). However, the lack of evidence of harmful effects from their use by the consuming public over a period of twenty years and negative evidence of harmfulness in a laboratory study (2) have resulted in the general acceptance of pyrophosphates as baking compounds. Moreover, it has been shown (3) that pyrophosphates are utilized practically as well as orthophosphates for meeting the phosphorus requirements of rats. It is therefore evident that certain compounds may not only serve a useful purpose in baking, but may also contribute to the nutritional supply of some essential mineral element. Evidence of the nutritive value of mono-calcium phosphate extensively used in self-rising flours, particularly in southern states was further indicated in a comparative study of the nutritional value of various types of bread and biscuits (4).

The use of alum baking powders and aluminum kitchen ware has also been subject to criticism and attack at various times. Much of this effort to discourage the use of aluminum products has been of commercial origin and must therefore be discredited. The fact is that not very much is known about the biological role of aluminum and about the limits of tolerance for this element.

It has been shown that aluminum could be detected in the blood of dogs fed an aluminum free diet supplemented with an alum baking powder (5). There was however no evidence of a cumulative effect in the blood. A study of the aluminum balance of pre-school children led to the conclusion that aluminum is not essential at this stage of life (6). On the other hand, it may be significant that aluminum is present in

many tissues of the body such as brain, heart, liver, kidney and spleen (7). Evidently the requirement is very slight because it has been shown that one microgram per day of aluminum will satisfy the need of the rat (8). More specifically, it has been demonstrated that the addition of a minute amount of aluminum will accelerate the oxygen uptake in a succinic dehydrogenase-cytrochrome system (9). That fairly large amounts of aluminum are well tolerated by rats is shown by the fact that rats fed diets containing one per cent of sodium aluminate or of one per cent aluminum acetate remained in good health throughout the period of the experiment (10).

It was the purpose of this study to determine the wholesomeness of a new baking compound developed by the Victor Chemical Company of Chicago, Illinois. The compound was a complex sodium aluminum acid phosphate to which the formula $NaAl_3H_{14}(PO_4)_8 \cdot 3H_2O$ was assigned. This compound will be referred to as "Al.P." throughout the paper.

EXPERIMENTAL PART II

In order to determine the wholesomeness of the baking compound, it was planned to use a generation type of feeding test involving reproduction and rearing of two litters by each female. Accordingly, several groups of young rats were assembled in such a way as to provide the greatest possible similarity as to sex, weight and litter origin. The animals, which were weighed weekly, were segregated as to sex until they had attained sexual maturity at which time they were assembled into comparable breeding groups composed of three females and one male. At least two litters were obtained from each female. When pregnancy was apparent, each female was segregated and allowed to remain with the young for twenty-one days. In order to achieve greater uniformity in the growth of the young, all large litters were reduced to seven. Smaller litters were raised but the results were not included in the general averages except in the case of litters of six animals. The young were weighed at twenty-one days and again at twenty-five days being continued on the ration used in raising the parents.

A comparison was made between groups receiving the stock ration used in this laboratory and the same ration supplemented with one per cent of the baking compound.

The stock ration had the following composition:

Yellow Corn Meal	35%
Ground Whole Wheat	25%
Powdered Whole Milk	20%
Linseed Oil Meal	10%
Alfalfa Loaf Meal	6%
Brewer's Yeast	3%
Table Salt	1%

The results of this experiment are summarized in tables I and II. More extensive data are given at the end of the thesis. (PP 15,16,17,18)

Table I

Ration	Sex	Number of Animals	Initial Weight (Grams)	Average Weight at 5 Weeks	Average Weight at 10 Weeks	11 Animals Final Weight
Stock	♀	12	67.5	165.4	211.9	298.5
Stock	♂	4	85.7	196.3	283.0	476.5
Stock + 1% "Al.P."	♀	12	66.3	161.8	212.1	298.0
Stock + 1% "Al.P."	♂	4	83.7	210.3	290.8	478.5

Table II

Litter Wts.:

Ration	Number of Animals	Average Weight at 21 days (Grams)	Average Weight at 25 days (Grams)
Stock	62	37.6	46.9
Stock + 1% "Al.P."	62	38.1	46.9

Discussion:

It is apparent from the data in tables I and II that there were no significant differences in the growth of the original animals nor in their offspring. The animals in both groups appeared to be identical in every respect. It may therefore be concluded that the addition of one per cent of the new baking compound to the stock ration was without noticeable effect on growth, reproduction and rearing of the young.

EXPERIMENTAL PART III

Inasmuch as the baking compound under investigation would normally be ingested in a prepared food, the second part of the study involved the use of biscuits prepared with the baking compound. The following recipe was used to prepare the biscuits:

Flour	400 gm.
$NaHCO_3$ (C.P.)	5 gm.
"Al.P."	5 gm.
Table salt	8 gm.
Crisco	8 tablespoonsful
Milk	11 fl. oz.

The biscuits were baked in an electric over at 450° for 30-35 minutes. They were then air-dried, ground and incorporated in a diet which consisted of the following:

Ground dry biscuit	55%
Whole milk powder	25%
Alfalfa loaf meal	10%
Casein (edible commercial)	5%
Brewer's yeast	4%
Table salt	1%

The diet was compared with the stock ration using two groups of rats selected and managed as previously described. The results are summarized in tables III and IV with more extensive data given at the end of the thesis. (PP 19, 20, 21, 22)

Table III

Ration	Sex	Number of Animals	Initial Weight (Grams)	Weight at 5 Weeks (Grams)	Weight at 10 Weeks (Grams)	Final Weight
Stock	♀	6	64.2	152.8	195.2	229.0
Stock	♂	2	75.5	244.4	327.0	431.5
Biscuit	♀	6	68.7	164.8	193.7	236.8
Biscuit	♂	2	77.5	245.0	327.0	452.5

Table IV

Litter Wt.: Ration	Number of Animals	Average Weight at 21 days (Grams)	Average Weight at 25 days (Grams)
Stock	36	35.3	46.7
Biscuit	39	36.2	48.0

Discussion:

The results in tables III and IV indicate that a diet containing fifty-five per cent of dried biscuits baked with the "Al.P." sustained as good growth and permitted as good reproduction and rearing of young as did the stock ration. This is further evidence of the wholesomeness of the new baking compound.

EXPERIMENTAL PART IIIII

To determine the availability of the phosphorus in the "Al.P.", varying quantities of the baking compound were added to a rachitogenic diet, both in the form of the acid salt and after neutralization with sodium bicarbonate. This procedure was used because of the findings of Zucker et al. (11) and Lynch (3) who showed that when enough available phosphorus was added to a rachitogenic diet, normal growth and bone development resulted. This use of a rachitogenic diet in the production of experimental rickets is based on the fact that when the phosphorus of the diet is limited in amount and restricted to cereal sources in which much of the phosphorus is in the form of phytin, the inclusion in the diet of a large amount, three per cent, of calcium carbonate will so decrease the utilization of the phosphorus that the calcification of the skeleton is practically inhibited. The development of rickets is therefore due to a very low concentration of inorganic phosphorus in the blood (13). This is attributed according to Steenboch, to the precipitation of the phytin by calcium before hydrolysis of the former can occur; thus the phosphorus is unavailable for absorption (14). The addition of available phosphorus to the diet tends to elevate the inorganic phosphorus content of the blood and thus restores the calcifying process.

Young animals weighing between forty and fifty grams were fed the rachitogenic diet containing various levels of the free baking compound and the neutralized baking compound. The neutralized form of the baking compound was prepared by mixing the "Al.P." with sodium bicarbonate in the ratio used in baking (1:1) adding water and then evaporating to dryness on a steam bath. The rachitogenic diet used had the following composition:

Yellow corn meal	63%
Gluten	20%
Ground whole wheat	10%
Yeast	3%
$CaCO_3$	3%
Table salt	1%

In view of the fact that 1 gram of "Al.P." was equivalent to 1.34 grams of the neutralized "Al.P.", the baking compound was added to the rachitogenic diet in the quantities of 1, 2, 3 and 4 per cent by weight; the neutralized compound was added in quantities of 1.34, 2.68 and 4.02% by weight. The animals were weighed once a week and sacrificed at the end of the fourth week at which time blood samples were taken and one femur dissected from each animal. The blood was analyzed for inorganic phosphorus using the Youngburg method and the Fischer photoelectric colorimeter using the 425 mu filter. The method was modified to the extent of using a blank and allowing the blank, standard and unknown to stand for five minutes instead of one minute. The per cent transmission was converted to optical density using the table on page 472 in "Practical Physiological Chemistry" by Hawk, Oser and Summerson. The milligrams per cent of phosphorus was calculated by the formula:

$$\text{Concentration of Unknown} = \frac{\text{Density of Unknown}}{\text{Density of Standard}} \times \text{Concn of Standard} \times 100$$

MGM %

The dissected femora, cleared of adhering tissue, were extracted with 95% ethanol and ashed. The summarized results are given in table V and more detailed data are given at the end of the thesis. (PP 23)

Table V

Ration	Number of Animals	% Bone Ash	Blood Inorganic Phosphorus (mgm %)	Average Final Weight (Grams)	Average 4-week gain in Weight (Grams)
Stock	12	41.47	5.25	103.83	62.67
Basal Rachitogenic	12	15.12	2.31	78.00	26.83
Basal + 1% "Al.P."	12	17.69	3.53	89.00	42.67
Basal + 2% "Al.P."	12	29.86	4.10	97.33	52.67
Basal + 3% "Al.P."	12	41.84	5.47	100.83	57.66
Basal + 4% "Al.P."	12	40.33	4.62	91.67	51.33
Basal + 1.34% neutralized "Al.P."	12	20.38	3.59	81.50	37.83
Basal + 2.68% neutralized "Al.P."	12	42.96	5.25	101.66	59.00
Basal + 4.02% neutralized "Al.P."	12	42.06	4.53	100.66	52.33

Discussion:

It is evident from the results shown in table V that with an increase in the amount of "Al.P.", either as the acid salt or the neutralized form, added to the basal diet there is an increase in blood phosphorus, bone ash and weight gained over the four-week period. This increase reaches a maximum with the 3% level for the acid salt and the 2.68% level for the neutralized form. This indicates that the phosphorus in the neutralized form is more effectively utilized than that of the acid salt. Further evidence of this difference in availability is indicated by the fact that adverse effects are attained at levels of 4% of the acid salt and 4.02% of the neutralized form, inasmuch as the 4.02% of the latter supplies the same amount of phosphorus as 3% of the acid salt. It is known that the addition of acid to a rachitogenic diet affects the degree of rickets developed in rats so that the differences observed between the two forms may perhaps be due to this factor. The fact that both forms are readily assimilated indicates that this baking compound may be considered as a potential source of

phosphorus in human diets.

SUMMARY:

1. The addition of one per cent of the sodium aluminum acid phosphate to a normal diet has no ill effects whatsoever in rats as judged by growth, reproduction and rearing of young.

2. A diet containing fifty-five per cent of biscuits prepared with this baking compound supported normal growth, reproduction and rearing of young in rats.

3. The new baking compound may therefore be regarded as wholesome.

4. The addition of the sodium aluminum acid phosphate or its neutralized form to a rachitogenic diet indicated that the phosphorus supplied by either form was readily available.

5. The new baking compound, sodium aluminum acid phosphate, is therefore a potential source of phosphorus for nutritional purposes.

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STOCK RATION

Weight in Grams

Date	♀1	♀2	♀3	♀4	♀5	♀6	♂1	♂2
2/5/47	57	80	65	73	60	77	50	65
2/12	76	100	80	94	82	102	64	86
2/19	100	126	104	122	112	135	96	130
2/26	110	146	126	146	136	156	128	166
3/5	124	166	146	160	156	166	160	200
3/12	138	186	166	176	176	178	190	232
4/9	168	212	183	196	216	210	244	276
4/16	174	217	195	220	225	220	295	327
4/23	174	221	210	235	235	240	313	350
4/30	190	235	227	245	240	250	330	365
5/7	200	225	263	245	250	260	345	380
5/14	203	228		260	255	278	358	390
5/21	210	235	240	280	260	333	380	410
5/28	220	243			270		380	410
6/18			230				430	445
6/25	250	272				240	430	440
7/2	250	275				255	350	450
7/9	260	260	250	270	300	260	370	430
7/16	280	270	265	290	295	285	380	460
7/23		290	270		300	330	390	450
7/30		305	310			Died	400	470
8/6					315		430	475
8/13				334	330		463	480
8/20	256	260		284			458	463
8/27	260	262		302			464	468
9/10		316	284				470	478
10/1			295		346		525	535
10/8			307		352			
10/22	304	332	318	356	364		514	530

Matings: 1. ♀1, ♀2, ♀5, ♂1
2. ♀2, ♀4, ♀6, ♂2

STOCK + 1% "AL.P."

Date	♀7	♀8	♀9	♀10	♀11	♀12	♂3	♂4
2/5/47	60	85	60	60	57	84	55	61
2/12	72	113	70	84	82	114	76	84
2/19	90	143	96	114	108	138	116	118
2/26	102	164	110	138	136	156	150	158
3/5	120	182	125	156	154	174	185	193
3/12	138	200	140	172	170	188	218	228
4/9	164	235	205	184	208	210	312	288
4/16	175	213	215	225	235	196	327	300
4/23	182	245	235	245	220	215	350	320
4/30	200	264	260	280	224	245	360	335
5/7	220	300			240	247	375	340
5/14					258	255	385	350
5/21		301	237	220	305	285	419	380
5/28	225	310	280		315	330	410	380
6/18					330		420	430
6/25	240	270	290	260			430	420
7/2				270			430	425
7/9			260	290			440	440
7/16			295				460	450
7/23	250	303	330		298	280	470	455
7/30	255				310	300	470	460
8/6	262	325			317		475	462
8/13	313			280	362		470	457
8/20			290	290			475	455
8/27			286	296		288	460	454
9/10				348			478	468
10/1	310	318					510	505
10/8	322	352	330		336	342	514	
10/22	348	388	342	305	345	354	510	520

Matings: 1. ♀7, ♀8, ♀11, ♂3
2. ♀9, ♀10, ♀12, ♂4

STOCK RATION

Date	♀13	♀14	♀15	♀16	♀17	♀18	♂5	♂6
3/13/47	60	70	66	66	72	64	68	64
4/2	119	134	142	142	132	143	152	130
4/16	135	163	169	169	150	179	190	173
4/23	145	180	195	190	162	195	190	195
4/30	147	188	205	200	170	209	200	210
5/7	158	195	217	215	182	220	214	230
5/14	165	203	225	220	185	230	233	245
5/21	180	222	228	225	200	240	245	265
5/28	178	220	240	238	200	240	260	265
6/18	193	255	270	260	220	265	305	315
6/25	190	258	275	265	228	262	312	320
7/2	185	250	270	275	230	270	300	310
7/9	190	260	265	270	245	268	290	315
7/16	245	275	275	280			300	325
7/23		300					310	360
7/30							320	365
8/6			283				330	372
8/13	310		280	300	253		350	360
8/20	310	262	300	330	265	285	360	365
8/27	320	268				294	360	371
9/10		300	288	312			380	387
10/1	230		307		288	313	392	402
10/8	248			314	290	358	402	413
10/29	287		286	325	322		425	425
11/5	300	357	295	338	320	335	430	432

Matings: 1. ♀14, ♀13, ♀15, ♂6
2. ♀18, ♀17, ♀16, ♂5

STOCK + 1% "AL.P."

Date	♀19	♀20	♀21	♀22	♀23	♀24	♂7	♂8
3/13/47	66	70	70	54	70	60	70	65
4/2	105	125	136	126	106	126	146	126
4/16	135	150	167	155	160	167	210	185
4/23	150	170	172	170	153	186	230	205
4/30	158	179	176	175	163	194	250	219
5/7	172	192	200	195	174	200	270	230
5/14	177	203	212	202	188	216	278	240
5/21	190	215	235	214	202	230	292	250
5/28	180	210	240	220	203	228	290	252
6/18	210	240	268	242	232	260	285	270
6/25	200	230	270	245	234	260	310	290
7/2	210	240	260	250	245	272	340	295
7/9	212	250	265	253	252	275	350	297
7/16		265	280	315		305	360	310
7/23		270	320	320		315	370	320
7/30		300		343			370	340
8/6		320					375	352
8/13	235				272	252	370	350
8/20	240	278		278	277	259	380	360
8/27			280	280	316	274	360	360
9/10			332				378	380
10/1	242			265		298	411	415
10/8	320	282	306	300	302	311	416	432
10/29		310	337		320	344	435	433
11/5	329	315	344	298	330	352	443	441

Matings: 1. ♀19, ♀20, ♀21, ♂7
2. ♀23, ♀24, ♀22, ♂8

STOCK RATION

Date	♀25	♀26	♀27	♀28	♀29	♀30	♂9	♂10
7/26/47	52	68	69	53	72	71	73	78
8/2	71	91	92	70	95	84	113	113
8/9	88	109	106	80	116	106	142	140
8/16	110	130	133	110	135	132	188	181
8/23	118	143	142	124	148	150	214	206
8/30	135	160	156	147	153	166	250	238
9/6	146	160	166	153	160	167	273	260
9/13	155	168	173	164	174	183	292	288
9/27	168	183	188	186	193	105	323	316
10/4	176	188	198	201	202	216	336	318
10/11	195	206	210	214	212	235	356	322
10/18	214	220	234	226	240	236	358	342
10/25				225	248	248	364	345
11/1				226		277	387	358
11/8				242			403	370
11/22	204	181			220		411	388
11/29	220	198				265	418	400
12/6	255	222	262			273	427	410
12/13	218	240	255	213		273	411	390
12/20	213		292	230		308	412	395
1/10/48	230			221	214		432	360
1/17		215	210	252	240	235	430	370
1/31		243	254		280	260	410	408
2/21	238	227	232	248	214	215	447	416

Matings: 1. ♀25, ♀26, ♀27, ♂9
2. ♀28, ♀29, ♀30, ♂10

BISCUIT RATION

Date	♀31	♀32	♀33	♀34	♀35	♀36	♂11	♂12
7/26/47	65	52	70	80	68	77	76	79
8/2	90	82	98	107	95	104	116	117
8/9	103	103	115	118	110	126	150	147
8/16	127	123	151	140	137	149	190	184
8/23	145	134	160	146	147	158	215	222
8/30	165	145	180	160	168	171	240	250
9/6	170	153	187	165	170	180	256	268
9/13	175	163	200	172	185	186	285	287
9/27	185	174	211	180	200	204	318	320
10/4	178	184	220	184	186	210	330	324
10/11	186	194	228	192	218	226	346	324
10/18	203	208	242	212	242	265	365	350
10/25	213	214		241			360	350
11/1							377	357
11/8							384	380
11/22	210	242		210		230	396	391
12/6	217	225	272	262			414	422
12/13	217	230		285			397	400
12/20	222	244					403	402
1/10/48	248	250	260	252		253	400	390
1/17	260		273		260	260	410	415
1/31							440	435
2/17	210	214					450	445
2/21	210	221	285	225	273	214	454	451

Matings: 1. ♀31, ♀32, ♀33, ♂11
2. ♀34, ♀35, ♀36, ♂12

WEIGHT OF LITTERS

Animal	Ration	No. in orig. Litter	No. in Litter Weighed	Wt. of Litter at 21 days	Wt. of Litter at 25 days
♀1	Stock	9	7		267
		9	7	255	324
♀2	Stock	11	7	225	273
		9	7	335	402
♀3	Stock	10	5	212	260
♀4	Stock	9	7	254	324
		6	4	205	248
♀5	Stock	9	7	207	256
		8	6	213	268
♀13	Stock	9	7	168	223
		7	7	170	214
♀14	Stock	8	7	235	299
		8	6	165	189
♀15	Stock	8	7	219	274
		11	7	171	208
♀16	Stock	11	7	217	253
		7	7	223	290
♀17	Stock	9	7	231	283
		9	7	320	396
♀18	Stock	11	3	152	208
		12	7	193	241
♀7	Stock+1% "Al.P."	8	7		350
		10	7	198	246
♀8	Stock+1% "Al.P."	3	3		210
		9	7	249	310
♀9	Stock+1% "Al.P."	9	7	236	318
♀10	Stock+1% "Al.P."	8	7	274	361
		8	7	290	353
♀11	Stock+1% "Al.P."	7	7	238	306
♀12	Stock+1% "Al.P."	9	7	315	371
		6	6	212	271
♀19	Stock+1% "Al.P."	9	7	168	217
		9	7	169	225
♀20	Stock+1% "Al.P."	7	7	274	346
		8	6	225	286

Animal	Ration	No. in orig. Litter	No. in Litter Weighed	Wt. of Litter in 21 days	Wt. of Litter in 25 days
♀21	Stock+1% "Al.P."	8	7	236	318
		8	5	197	244
♀22	Stock+1% "Al.P."	6	6	232	324
		7	5	231	264
♀23	Stock+1% "Al.P."	12	7	231	283
		9	7	173	236
♀24	Stock+1% "Al.P."	8	7	251	327
		7	7	237	315
♀25	Stock	8	7	204	243
		8	5	196	252
♀26	Stock	8	6	167	216
		11	6	155	208
♀27	Stock	5	3	121	145
		8	3	107	137
♀29	Stock	7	6	170	215
		9	6	187	227
♀30	Stock	8	6	209	250
		6	6	250	301
♀31	Biscuit	8	5	176	248
		8	7	192	271
♀32	Biscuit	8	6	174	236
		8	7	251	291
♀33	Biscuit	6	6	271	356
		9	6	285	347
♀34	Biscuit	7	7	260	330
		8	6	241	276
♀35	Biscuit	6	3		247
♀36	Biscuit	7	6	203	238
		8	7	312	364

Ration	Number of Animals	Weight of Bones (Grams)	Weight of Ash (Grams)	% Ash	Blood Inorganic Phosphorus (mgm %)	Average Final Weight (Grams)	Average 4-Week Gain in Weight (Grams)
Stock	4	1.1124	0.4708	42.32	5.40	108.50	69.00
	4	0.9706	0.3990	41.12	5.25	103.00	60.50
	4	0.9664	0.3958	40.96	5.11	100.00	58.50
Basal	4	0.6358	0.0996	15.67	2.35	82.50	29.50
	4	0.6410	0.0978	15.39	2.30	78.00	25.50
	4	0.7878	0.1124	14.27	2.28	73.50	25.50
Basal + 1% "Al.P."	4	0.8442	0.1487	17.61	3.55	89.50	42.50
	4	0.8316	0.1429	17.30	3.31	82.00	34.50
	4	0.8568	0.1556	18.16	3.73	95.50	51.00
Basal + 1% "Al.P."	4	1.0316	0.3010	29.18	4.03	89.00	43.00
	4	0.8996	0.2754	30.61	4.15	105.50	56.50
	4	1.1221	0.3344	29.80	4.12	97.50	58.50
Basal + 3% "Al.P."	4	0.9209	0.3213	40.36	5.32	97.50	53.50
	4	1.1345	0.4806	42.36	5.55	106.00	63.50
	4	1.1208	0.4797	42.80	5.53	99.00	56.00
Basal + 4% "Al.P."	4	1.0488	0.4098	39.24	4.43	90.50	50.00
	4	0.9347	0.3780	40.44	4.62	91.00	51.50
	4	0.8853	0.3658	41.32	4.81	92.50	52.50
Basal + 1.34% Neutralized "Al.P."	4	0.8234	0.1746	21.21	3.80	87.50	42.50
	4	0.9716	0.2016	20.67	3.78	80.00	36.50
	4	1.1585	0.2425	19.27	3.18	77.00	34.50
Basal + 2.68% Neutralized "Al.P."	4	0.7785	0.3241	41.63	5.14	97.50	59.00
	4	0.8318	0.3672	42.87	5.24	101.50	61.00
	4	0.9724	0.4314	44.37	5.38	106.00	57.00
Basal + 4.02% Neutralized "Al.P."	4	0.9096	0.3811	41.90	4.54	100.00	54.00
	4	0.8450	0.3635	43.02	4.68	104.00	52.50
	4	0.8194	0.3381	41.26	4.37	97.00	50.50