ACRYLAMIDE

NOTEBOOK NO. 10

ISSUED TO G. SADLER

ON JAN. 07 20 05

DEPARTMENT

RETURNED JUNE 16 20 06

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TITLE Acrylamide vs Hunter "L" value, in standard Piecrust

BACKGROUND-

Considerable work over the past six months has examined the acrylamide level in home prepaired foods. Those data indicated acrylamide mitagation was possible through minor modification's in formulation. The acrylamide lowering effect of egg white, yolk and whole egg as well as pH control of the food material showed particular promise. However, all variations on a formulation received the same cooking time. In some formulations there was a clear correlation between ~~cooking~~ formulation and browning In particular, low pH batters browned more slowly. The question arose, "Did browning inhabition alone reduce acrylamide?" if so additional baking might geild higher acrylamide levels, at par with the standard formulation

Purpose: The purpose of this experiment is to determine acrylamide content of standard formulation pie crust as a function of Hunter "L" value. This exercise will identify how much acrylamide should be present at a certain browning level. This browning level/acrylamide content value can be adjusted to acrylamide equivalents at comparable browning levels for the basic formulation

Method

A) Standard precrust containing, Crisco Shortening, water, flour & salt was needed & rolled out using conventional technique for flakey piecrusts * See notes on formulation/preparation at section end.

B) Piecrust was cooked to various stages of brawness.

Oven Temp 425°F

c) L, a, b Hunter color readings were measured, both for piecrust surface and for ground crust.

Recorded by:	Date	Verified by:	Date
C. Sadler	1/21/05	Helena A. Miller	1/21/05

Project No. Acrylamide

Book No. 1 TITLE Acrylamide vs Hunter Color (cont. from pg 1)

D. A graph of acrylamide vs Hunter "L" value was drawn (see figure # 1-1). Raw data is found in table 1-1

Basic Pie Crust, STD Colors 1-5, Set #1 (Not Ground), January 05, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 10	BASIC PIE CRUST ST NO 5 BOTTOM, set 1	26.65	10.46	17.29	69.77
Sample 9	BASIC PIE CRUST ST NO 5 TOP, set 1	43.41	9.37	26.3	57.07
Sample 8	BASIC PIE CRUST ST NO 4 BOTTOM, set 1	34.39	13.05	25.14	65.39
Sample 7	BASIC PIE CRUST ST NO 4 TOP, set 1	49.18	8.18	26.4	51.91
Sample 6	BASIC PIE CRUST ST NO 3 BOTTOM, set 1	48.34	10.16	30.18	54.92
Sample 5	BASIC PIE CRUST ST NO 3 TOP, set 1	54.4	5.77	23.6	45.68
Sample 4	BASIC PIE CRUST ST NO 2 BOTTOM, set 1	55.92	4.24	24.03	44.4
Sample 3	BASIC PIE CRUST ST NO 2 TOP, set 1	56.75	2.43	17.77	40.56
Sample 2	BASIC PIE CRUST ST NO 1 BOTTOM, set 1	58.36	1.68	18.24	39.25
Sample 1	BASIC PIE CRUST ST NO 1 TOP, set 1	57.21	1.99	16.28	39.51

NOT GROUND SAMPLES SUFFERED FROM LOWER R^2 between L & Acrylamide ~0.94 vs 0.98

For ground WAS SELECTED FOR FURTHER STUDY

SEE FIGURE 1-1b

Basic Pie Crust, STD Colors 1-5, Set #1 (Ground), January 05, 2005

GROUND = SELECTED for Study

1	BASIC PIE CRUST STD NO 5(GROUND), SET1	46.52	14.37	33.07	58.93
2	BASIC PIE CRUST STD NO 4(GROUND), SET1	55.41	12.75	34.95	52.84
3	BASIC PIE CRUST STD NO 3(GROUND), SET1	69.98	6.82	29.88	38.06
4	BASIC PIE CRUST STD NO 2(GROUND), SET1	73.81	3.38	24.21	30.76
5	BASIC PIE CRUST STD NO 1(GROUND), SET1	77	1.51	19.4	24.86

Basic Pie Crust, STD Colors 1-5, Set # 2 (Not Ground) January 06, 2005

	ID	L*	a*	b*	DE*
Standard		93.51	-0.93	1	
Tolerance +					
Tolerance -					
Sample 10	BASIC PIE CRUST STD COLOR 5, BOT, SET 2	27.06	11.88	19.61	70.18
Sample 9	BASIC PIE CRUST STD COLOR 5, TOP, SET 2	39.99	11.64	28.42	61.44
Sample 8	BASIC PIE CRUST STD COLOR 4, TOP, SET 2	46.18	8.3	27.16	54.86
Sample 7	BASIC PIE CRUST STD COLOR 4, BOT, SET 2	32.17	12.46	24.17	66.92
Sample 6	BASIC PIE CRUST STD COLOR 3, BOT, SET 2	49.62	8.82	28.97	52.95
Sample 5	BASIC PIE CRUST STD COLOR 3, TOP, SET 2	53.29	5.38	23.27	46.4
Sample 4	BASIC PIE CRUST STD COLOR 2, TOP, SET 2	56.85	3.91	23.8	43.45
Sample 3	BASIC PIE CRUST STD COLOR 2, TOP, SET 2	56.03	2.93	19.67	42.05
Sample 2	BASIC PIE CRUST STD COLOR 1, BOT, SET 2	59.36	1.37	17.22	37.88
Sample 1	BASIC PIE CRUST STD COLOR 1, TOP, SET 2	58.45	1.79	15.17	37.91

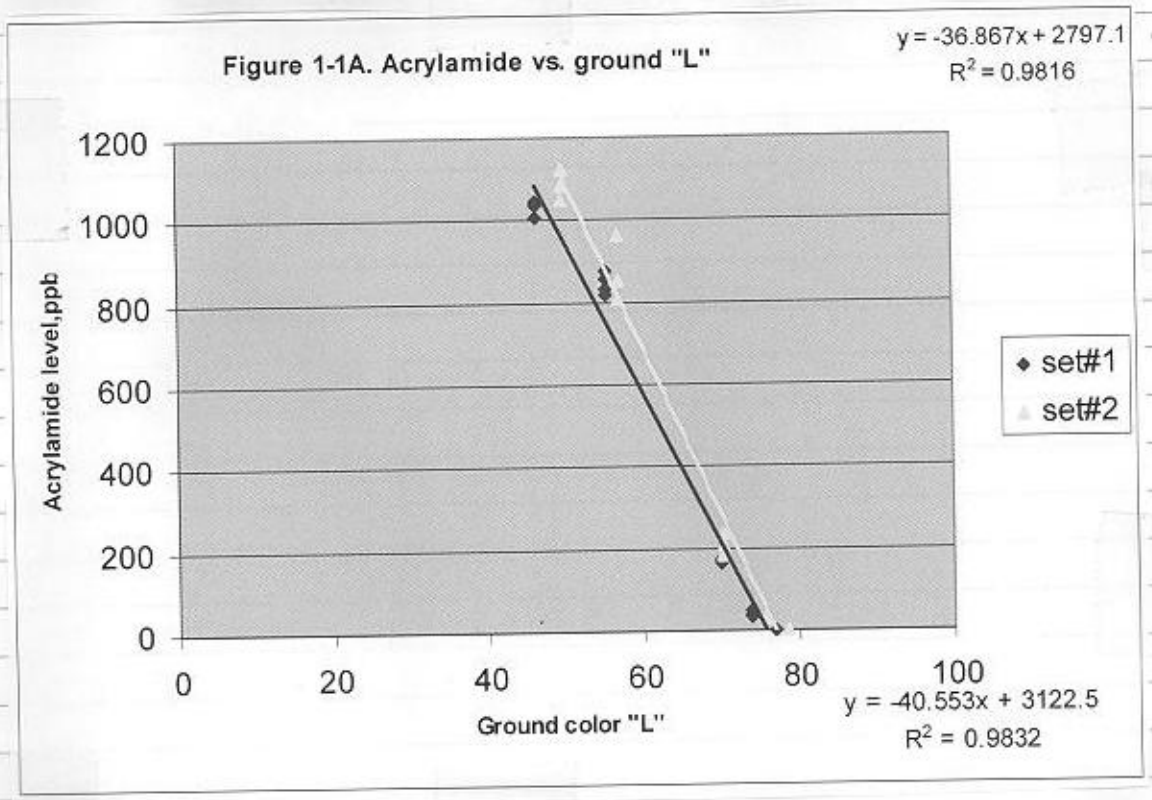
NOT GRAPHED; NOT STUDIED; SEE NOTE ABOVE & Fig 1-1b

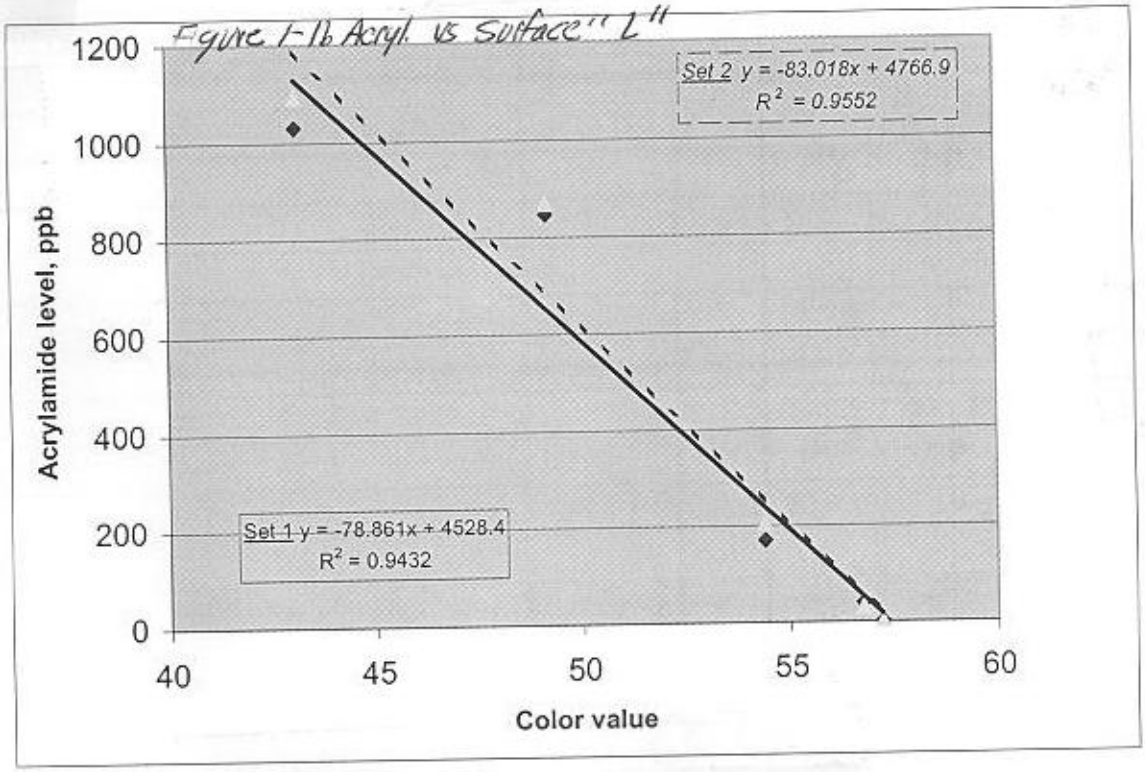
Basic Pie Crust, STD Colors 1-5, Set # 2 (Ground), January 06, 2005

BASIC PIE CRUST STD COLOR 1, SET 2	78.56	1.55	18.84	23.42
BASIC PIE CRUST STD COLOR 2, SET 2	75.53	3.1	23.96	29.44
BASIC PIE CRUST STD COLOR 3, SET 2	70.23	6.67	28.87	37.11
BASIC PIE CRUST STD COLOR 4, SET 2	56.86	11.98	34	50.98
BASIC PIE CRUST STD COLOR 5, SET 2	49.66	13.38	32	55.58

Recorded by:	Date	Verified by:	Date
Paige Nolen	1-21-05	Elena A. Miller	01/21/05

TITLE Acrylamide vs Hunter Color "L" values Book No. 1





Note: Figure 1-1a has a R² value of 0.943; this color vs acrylamide correlations will use ground sample b

Recorded by: Bruce D Hall Date 1-21-05 Verified by: Date

4 Project No. Acrylamid

Book No. _____ TITLE Acrylamide vs Hunter "L"

NOTES ON PREPARATION OF BASIC PIE CRUST

Basic Pie Crust 101

This recipe has been used for years...always with success. You too, can become *the* 'Pie-Maker' within your circle of family and friends. The helpful tips and suggestions listed below will enable you to create a pie crust you can be proud to serve.

1 1/3 cup all-purpose flour
1/2 cup Crisco brand shortening (see Cook's Note)
1/2 teaspoon salt
3 tablespoons *ice* water

1. Mix flour and salt in mixing bowl. Cut shortening into the flour with a pastry cutter, until mixture resembles the texture of tiny split peas. Do not use your hands to try and mix it, the heat from you hands will melt the shortening, causing the pastry to be "heavy", not light and flaky.
2. Once mixture is the right texture, add the ice water and combine with a fork. It may appear as if it needs more water, it does not. Quickly gather the dough into a ball and flatten into a 4-inch-wide disk. Wrap in plastic, and refrigerate at least 30 minutes.

Makes 1 (9-inch) pie crust. Double recipe for a two-crusted pie.

To Roll-Out Dough:

1. Remove dough disk from refrigerator. If stiff and very cold, let stand until dough is cool but malleable.
2. Using a floured rolling pin, roll dough disk on a lightly floured surface from the center out in each direction, forming a 12-inch circle. To transfer dough, carefully roll it around the rolling pin, lift and unroll dough, centering it in an ungreased 9-inch regular or deep-dish pie plate. (Or you can fold dough in quarters, then place dough point in center of pie pan and unfold dough, whatever is easiest for you.)

Directions For Final Preparation

For One Baked Pie Shell (also called Baking Blind):
Place rolled-out pastry in pie plate, gently press against bottom and sides of pan. Trim overhanging edge of pastry about 1-inch from the pie plate's edge. Tuck this rim of dough underneath itself so that folded edge is flush with pan edge. Flute the edge. Prick crust thoroughly on the bottom and sides with the tines of a fork to help prevent the dough from blistering and "puffing up" as it bakes. Or, you can line the unbaked pastry shell with foil or parchment paper, fill with dried beans or rice, clean pebbles (a French practice) or specialty pie weights made of metal or ceramic. The weights and foil or parchment paper should be removed a few minutes before the baking time is over to allow the crust to brown evenly. Bake at 425*F (220*C) for about 15 to 18 minutes, or until light golden brown. Cool before filling. Proceed with recipe's directions.

Recorded by:	Date	Verified by:	Date
Joyce Miller	1-21-05	Elena A. Miller	01/21/05

TITLE Acrylamide vs Hunter "L" Book No. 1

TABLE 1-1 RAW ~~HUNTER~~ Acrylamide VALUES

Set 1 (Color Standard 1)		Set 2 (Color Standard 1)	
Sample ID	Acrylamide ppb	Sample ID	Acrylamide ppb
SC-1-A	nd	SC-2-1-A	nd
SC-1-B	nd	SC-2-1-B	nd
SC-1-C	nd	SC-2-1-C	nd
SC-1-D	nd	SC-2-1-D	nd
mean	nd	**mean**	nd

RELATED HUNTER "L" Value

⇒ "L" = 78.56

(Color Standard 2)		(Color Standard 2)	
SC-2-A	34	SC-2-2-A	32
SC-2-B	38	SC-2-2-B	30
SC-2-C	40	SC-2-2-C	30
SC-2-D	48	SC-2-2-D	30
mean	**40**	**mean**	**31**

⇒ "L" = 75.53

(Color Standard 3)		(Color Standard 3)	
SC-3-A	170	SC-2-3-A	183
SC-3-B	173	SC-2-3-B	189
SC-3-C	172	SC-2-3-C	235
SC-3-D	163	SC-2-3-D	208
mean	**170**	**mean**	**204**

⇒ "L" = 70.23

(Color Standard 4)		(Color Standard 4)	
SC-4-A	874	SC-2-4-A	810
SC-4-B	858	SC-2-4-B	962
SC-4-C	820	SC-2-4-C	850
SC-4-D	834	SC-2-4-D	851
mean	**847**	**mean**	**868**

⇒ "L" = 56.86

(Color Standard 5)		(Color Standard 5)	
SC-5-A	1034	SC-2-5-A	1082
SC-5-B	1045	SC-2-5-B	1122
SC-5-C	1006	SC-2-5-C	1048
SC-5-D	1039	SC-2-5-D	1121
mean	**1031**	**mean**	**1093**

⇒ "L" = 49.66

NOTE: THIS DATA IS GRAPHED IN FIGURE 1-1A ON PG 3 OF THIS NOTEBOOK

Recorded by:	Date	Verified by:	Date
Blaze Baker	1-21-05	Elena A. Miller	01/21/05

Project No. Acrylamide

Book No. 1 TITLE Acrylamide as a function of pie crust formulation

EXPERIMENT #2- Acrylamide as a function of PIE CRUST FORMULATION

Figure 2-1

Basic Pie Crust Recipe with Ascorbic Acid

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
0.45g of Ascorbic Acid (99%)
3 Tablespoons of Water

Basic Pie Crust Recipe with Vinegar

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 Tablespoon of Vinegar
2 Tablespoons of Water

SEVERAL FORMULATION WERE PREPARED ON THE BASIC PIECRUST THEME. SOME NEW INGREDIENT WAS ADDED. THE CONCENTRATION AND TYPE OF CHANGE ARE GIVEN IN THE RECIPE FORMULATIONS TO THE LEFT AN INCLUDE

1) ASCORBIC ACID AN ANTIOXIDANT AND ACIDULANT

2) VINEGAR - AN ACIDULANT

Figure 2-1 cont

Basic Pie Crust Recipe with Egg White

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 egg white (33.8 g)
2 Tablespoons of Water

Basic Pie Crust Recipe with Egg Yolk

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 egg yolk (19.1 g)
2 ½ Tablespoons of Water

3) Egg White - PREVIOUS STUDIES SUGGESTED THESE LOW ACRYLAMIDE PERHAP THROUGH COMPETITION W/ CARBONYLS FORMERLY SHUNTED INTO ACRYLAMIDE

4) Egg Yolk Also suggested as an acrylamide lowering compound

Recorded by: | Date | Verified by: Elena A. Miller | Date

TITLE Acrylamide as a function of pie crust formulation Book No. 1

RESULTS

Table 2-1

Basic Pie Crust with vinegar, ascorbic acid, Set # 1 (Not Ground), January 21, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 4	BASIC PIE CR, ASCORB AC, BOT, SET1, 2005	64.94	2.71	22.79	36.13
Sample 3	BASIC PIE CR, ASCORB AC, TOP, SET1, 2005	64.69	2.94	21.71	35.71
Sample 2	BASIC PIE CRUST, VINEG, BOT, SET1, 2005	62.61	7.85	30.2	43.42
Sample 1	BASIC PIE CRUST, VINEG, TOP, SET1, 2005	64.78	5.58	25.09	38.07

Basic Pie Crust with vinegar, ascorbic acid, Set # 1 (Ground), January 21, 2005

Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -	GROUND				
Sample 6	BASIC PIE CR, ASCB AC, GROUD, SET1, 2005	73.24	2.99	23.82	30.79
Sample 5	BASIC PIE CR, VINEG, GROUND, SET1, 2005	70.86	4.59	26.39	34.49

Acrylamide Levels in Piecrust: Effect of Additives

Linear, Forced Zero Calibration Table 2-2

Ascorbic Acid	
Sample ID	Acrylamide ppb
AA-1-1	32
AA-1-2	29
AA-1-3	31
AA-1-4	30
mean	31

Vinegar	
Sample ID	Acrylamide ppb
Vin-1-1	133
Vin-1-2	118
Vin-1-3	120
Vin-1-4	132
mean	126

Egg Yolk	
Sample ID	Acrylamide ppb
EYol-1-1	nd
EYol-1-2	nd
EYol-1-3	nd
EYol-1-4	nd
mean	nd

Egg White	
Sample ID	Acrylamide ppb
EWh-1-1	nd
EWh-1-2	nd
EWh-1-3	nd
EWh-1-4	nd
mean	nd

Recorded by: | Date | Verified by: Elena A. Miller | Date

Project No. _____

Book No. _____ TITLE _____

TABLE 2-3

Basic Pie Crust with egg white, egg yolk, whole egg, Set # 1 (Not Ground), January 21, 2005

Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 12	BASIC PIE CR, WHOLE EGG, BOT, SET1, 2005	58.77	2.14	24.62	42.14
Sample 11	BASIC PIE CR, WHOLE EGG, TOP, SET1, 2005	58.53	1.79	21.87	40.84
Sample 10	BASIC PIE CR, EGG YOLK, BOT, SET1, 2005	57.63	3.58	26.17	44.07
Sample 9	BASIC PIE CR, EGG YOLK, TOP, SET1, 2005	58.41	2.8	23.98	42.14
Sample 8	BASIC PIE CR, EGG WHITE, BOT, SET1, 2005	58.04	2.26	22.19	41.45
Sample 7	BASIC PIE CR, EGG WHITE, TOP, SET1, 2005	58.17	2.82	20.57	40.59

Basic Pie Crust with egg white, egg yolk, whole egg, Set # 1 (Ground), January 21, 2005

Standard		93.53	-0.93	1	
Tolerance +	GROUND				
Tolerance -					
Sample 15	BASIC PIE CR, WHOLE EG, GROU, SET1, 2005	73.58	2.55	27.41	33.28
Sample 14	BASIC PIE CR, EG YOL, GROUND, SET1, 2005	74.92	3.59	29.19	34.08
Sample 13	BASIC PIE CR, EG WHT, GROUND, SET1, 2005	75.06	2.53	22.94	28.89

RESULTS: ASCORBIC ACID, VINEGAR, Egg White & Egg Yolk each exhibited Acrylamide lowering affects in pie crusts prepared to a constant baking time endpoint. JIFSAN Questioned whether reduction would be seen for a same-colored-endpoint

Recorded by:	Date	Verified by:	Date
		Elena A. Miller	

Figure 2-2 Acrylamide vs ground"L" in pie crust with ascorbic acid, vinegar

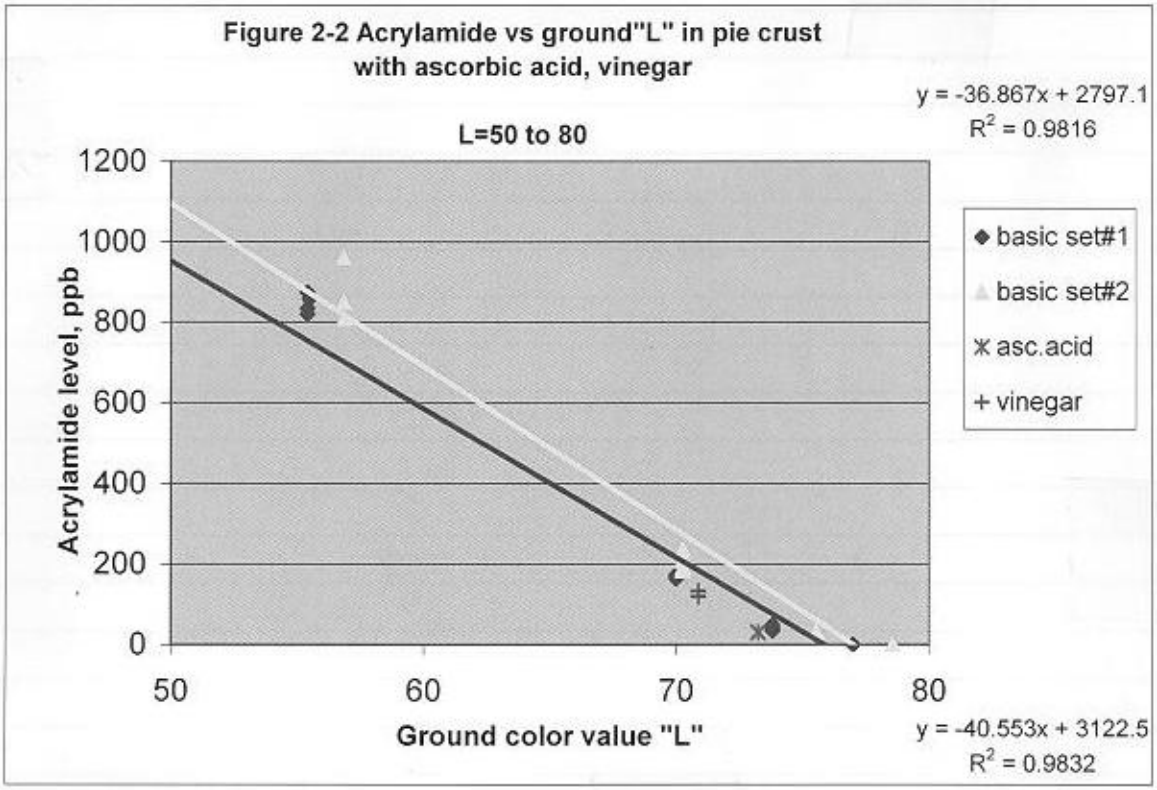
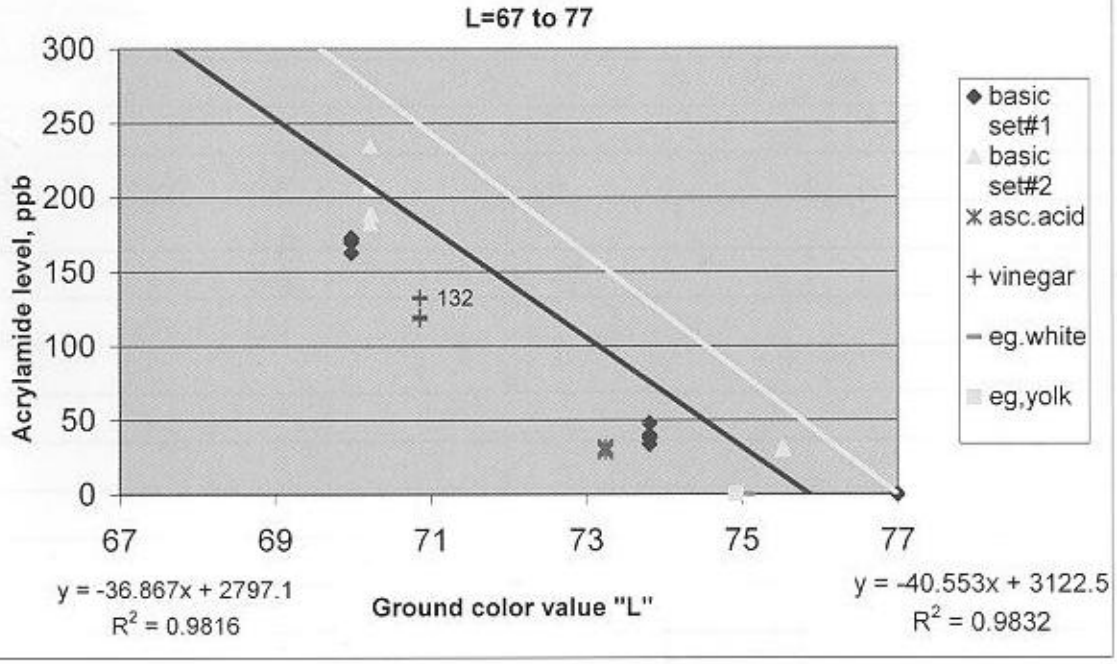


Figure 2-3. Acrylamide vs ground "L"in pie crust with ascorbic acid, vinegar, egg yolk, egg white



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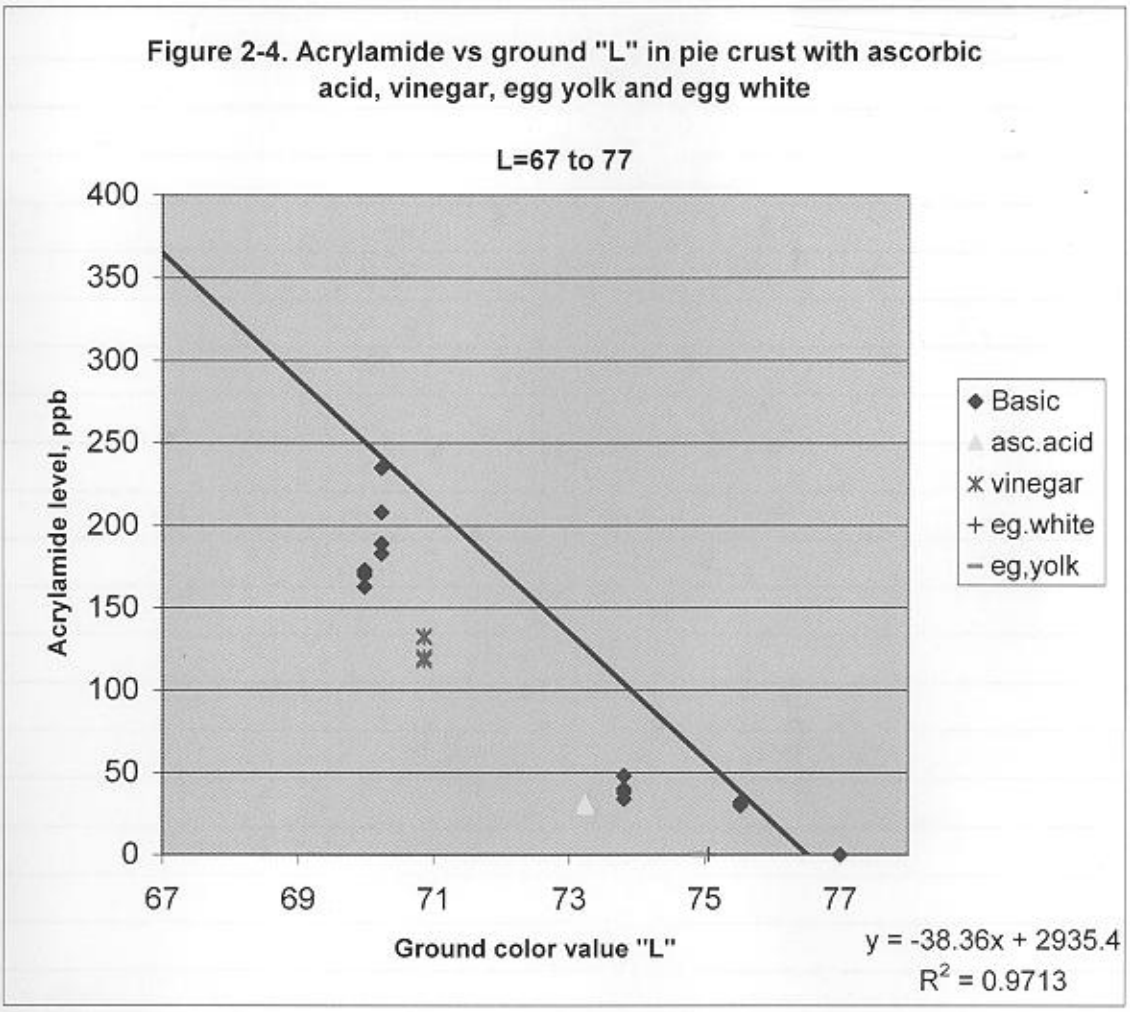

Table 2-4. Calculated acrylamide level

Added product to basic pie crust	Ground "L" value	Calculated acrylamide, ppb	Actual acrylamide, ppb
Egg yolk	74.92	62	0
Egg white	75.06	56	0
Ascorbic acid	73.24	126	31
Vinegar	70.86	217	126

RESULTS - AS INDICATED IN TABLE 2-4, EACH OF THE FOUR VARIANTS RESULTED (AS WITH CONSTANT TIME) IN REDUCED Acrylamide PRODUCTION. HOWEVER, ACRYLAMIDE LEVELS WERE ALSO FAIRLY LOW IN THE BASIC RECIPE PREPARED TO THE SAME LEVEL OF BROWNESS.

Conclusion - While it appears varied formulations resulted in lower acrylamide levels; it would be interesting to have more dramatic results These appear possible since some egg formulations resulted in Ø acrylamide. The potency of acrylamid reducing action for egg yolk & white MIGHT be better explored with darker, higher acrylamide level Product.

Recommendation for further study -

1) Repeat the experiment and take to a greater finished level of darkness.

2) Continue to explore other potential acrylamide forming pathways.

Recorded by:	Date	Verified by: Elena A. Miller	Date

Basic Pie Crust with Egg white, whole, wash, yolk, Sodium Thiosulfate, Cupric Sulfate
Set # 1, 2 (Ground), February 08, 2005

Standard		93.56	-0.94	1	
Tolerance +					
Tolerance -					
Sample 6	BAS PIE CR. W. EGG WASH, SET 2, 05	64.07	8.71	31.03	43.18
Sample 5	BAS PIE CR. W. EGG YOLK, SET 2, 05	62	9.95	33.14	46.34
Sample 4	BAS PIE CR. W. WHOLE EGG, SET 2, 05	60.03	11.23	34.48	48.92
Sample 3	BAS PIE CR. W. EGG WHITE, SET 2, 05	62.52	10.86	33.63	46.55
Sample 2	BAS PIE CR. W. SODIUM THIOSULF, SET1, 05	61.05	11.12	35.39	48.83
Sample 1	BAS PIE CR. W. CUPR. SULF, SET 1, 05	56.73	11.9	35.47	52.05

Basic Pie Crust Recipe with Whole Egg

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 egg (52 g)
1 ½ Tablespoons of Water

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Egg Yolk set 1		
Sample ID	Acrylamide ppb	Color"L"value
EYol-1-1	nd	74.92
EYol-1-2	nd	74.92
EYol-1-3	nd	74.92
EYol-1-4	nd	74.92
mean	**nd**	**74.92**

Egg White set 1		
Sample ID	Acrylamide ppb	Color"L"value
EWh-1-1	nd	75.06
EWh-1-2	nd	75.06
EWh-1-3	nd	75.06
EWh-1-4	nd	75.06
mean	**nd**	**75.06**

Egg Yolk set 2		
Sample ID	Acrylamide ppb	Color"L"value
EYol-2-1	508	62
EYol-2-2	479	62
EYol-2-3	533	62
EYol-2-4	463	62
mean	**496**	**62**

Egg White set 2		
Sample ID	Acrylamide ppb	Color"L"value
EWh-2-1	454	62.52
EWh-2-2	462	62.52
EWh-2-3	488	62.52
EWh-2-4	459	62.52
mean	**466**	**62.52**

Egg (whole) set 1		
Sample ID	Acrylamide ppb	Color"L"value
Egg-1-1	nd	73.58
Egg-1-2	nd	73.58
Egg-1-3	nd	73.58
Egg-1-4	nd	73.58
mean	nd	**73.58**

Egg (whole) set 2		
Sample ID	Acrylamide ppb	Color"L"value
Egg-2-1	482	60.03
Egg-2-2	458	60.03
Egg-2-3	440	60.03
Egg-2-4	456	60.03
mean	**459**	**60.03**

EggWash set 1		
Sample ID	Acrylamide ppb	Color"L"value
EggWash-2-1	498	64.07
EggWash-2-2	512	64.07
EggWash-2-3	562	64.07
EggWash-2-4	513	64.07
mean	**521**	**64.07**

Recorded by: Date Verified by: Helen A. Miller Date

Basic Pie Crust Recipe with Sodium Thiosulfate Anhydrous

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
0.01g of Sodium Thiosulfate Anhydrous
3 Tablespoons of Water

Basic Pie Crust Recipe with Cupric Sulfate

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
0.01g of Cupric Sulfate
3 Tablespoons of Water

Egg Wash:

1 egg whisked with 2 tablespoons of water

Thiosulfate set 1		
Sample ID	Acrylamide ppb	Color"L"value
TS-1-1	588	61.05
TS-1-2	524	61.05
TS-1-3	573	61.05
TS-1-4	536	61.05
mean	**555**	**61.05**

Cupric Sulfate set 1		
Sample ID	Acrylamide ppb	Color"L"value
CuSO4-1-1	809	56.73
CuSO4-1-2	815	56.73
CuSO4-1-3	868	56.73
CuSO4-1-4	792	56.73
mean	**821**	**56.73**

Done on; 04/05/05

E.M.

Basic Pie Crust Recipe with Tryptophan- 99%

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Tryptophan (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Gelatin, granular

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Gelatin (= 0.3% of flour weight)
3 Tablespoons of Water

Tryptophan set 1		April 05/2005
Sample ID	Acrylamide ppb	Color"L"value
TRYP-1	na	68.08
TRYP-2	138	68.08
TRYP-3	140	68.08
TRYP-4	174	68.08
mean	**151**	**68.08**

na = not available, peaks too small

Gelatin Set 1		April 05/2005
Sample ID	Acrylamide ppb	Color"L"value
Gel-1	220	68.3
Gel-2	242	68.3
Gel-3	235	68.3
Gel-4	236	68.3
mean	**233**	**68.3**

Project No. _____

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Basic Pie Crust with Tryptophan & Gelatin 0.03% (Ground) April 05, 2005

	ID	L*	a*	b*	DE*
Standard		93.52	-0.93	0.99	
Tolerance +					
Tolerance -					
Sample 2	BASIC PIE Crust with GELATIN	68.3	7.73	30.94	40.1
Sample 1	BASIC PIE Crust with TRYPTOPHAN	68.08	7.76	31.5	40.67

Basic Pie Crust with Lecitin & Albumin 0.03% (Ground) April 08, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	1.01	
Tolerance +					
Tolerance -					
Sample 2	BASIC PIE Crust with Lecitin	50.6	13.65	34.85	56.58
Sample 1	BASIC PIE Crust with Albumin	68.43	7.14	31.13	40.03

Recorded by:	Date	Verified by:	Date
		Elena A. Miller	

Basic Pie Crust Recipe with Albumin

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Albumin (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Lecithin

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Lecithin (= 0.3% of flour weight)
3 Tablespoons of Water

Lecithin Set 1		April 08/2005
Sample ID	Acrylamide ppb	Color"L"value
LEC-1	734	50.6
LEC-2	710	50.6
LEC-3	722	50.6
LEC-4	844	50.6
mean	**753**	**50.6**

Albumin Set 1		April 08/2005
Sample ID	Acrylamide ppb	Color"L"value
Alb-1	104	68.43
Alb-2	117	68.43
Alb-3	132	68.43
Alb-4	123	68.43
mean	**119**	**68.43**

Set 1

(Color Standard 1)		
Sample ID	**Acrylamide ppb**	**Color"L"value**
SC-1-A	nd	77
SC-1-B	nd	77
SC-1-C	nd	77
SC-1-D	nd	77
mean	nd	77

(Color Standard 2)		Color"L"value
SC-2-A	34	73.81
SC-2-B	38	73.81
SC-2-C	40	73.81
SC-2-D	48	73.81
mean	**40**	73.81

(Color Standard 3)		Color"L"value
SC-3-A	170	69.98
SC-3-B	173	69.98
SC-3-C	172	69.98
SC-3-D	163	69.98
mean	**170**	69.98

(Color Standard 4)		Color"L"value
SC-4-A	874	55.41
SC-4-B	858	55.41
SC-4-C	820	55.41
SC-4-D	834	55.41
mean	**847**	55.41

(Color Standard 5)		Color"L"value
SC-5-A	1034	46.52
SC-5-B	1045	46.52
SC-5-C	1006	46.52
SC-5-D	1039	46.52
mean	**1031**	46.52

Set 2/1 Set2/2

(Color Standard 1)				
Sample ID	Acrylamide ppb	Color"L"value		
SC-2-1-A	nd	78.56		
SC-2-1-B	nd	78.56		
SC-2-1-C	nd	78.56		
SC-2-1-D	nd	78.56		
mean	nd	78.56		

(Color Standard 2)		Color"L"value		
SC-2-2-A	32	75.53		
SC-2-2-B	30	75.53		
SC-2-2-C	30	75.53		
SC-2-2-D	30	75.53		
mean	**31**	75.53		

(Color Standard 3)		Color"L"value		
SC-2-3-A	183	70.23		
SC-2-3-B	189	70.23		
SC-2-3-C	235	70.23		
SC-2-3-D	208	70.23		
mean	**204**	70.23		

(4/12/2005)

(Color Standard 4)		Color"L"value	(Color Standard 4)	
SC-2-4-A	810	56.86	S3C4-1	781
SC-2-4-B	962	56.86	S3C4-2	867
SC-2-4-C	850	56.86	S3C4-3	702
SC-2-4-D	851	56.86	S3C4-4	743
mean	**868**	56.86	**mean**	**773**

(Color Standard 5)		Color"L"value		
SC-2-5-A	1082	49.66		
SC-2-5-B	1122	49.66		
SC-2-5-C	1048	49.66		
SC-2-5-D	1121	49.66		
mean	**1093**	49.66		

Recorded by: Date Verified by: Elena A. Miller Date

Set 3

(Color Standard 1)		
Sample ID	**Acrylamide ppb**	**Color"L"value**
Set 2 SC-1-1	nd	78.56
Set 2 SC-1-2	nd	78.56
Set 2 SC-1-3	nd	78.56
Set 2 SC-1-4	nd	78.56
mean	nd	78.56
	extracted on accident, same as set # 2	

	(Color Standard 2)	Color"L"value
Set 2 SC-2-1	36	75.53
Set 2 SC-2-2	37	75.53
Set 2 SC-2-3	33	75.53
Set 2 SC-2-4	28	75.53
mean	**34**	75.53
	extracted on accident, same as set # 2	

Baked on 3/1/2005

	(Color Standard 3)	Color"L"value
Set 2 SC-3-1	185	65.39
Set 2 SC-3-2	225	65.39
Set 2 SC-3-3	245	65.39
Set 2 SC-3-4	237	65.39
mean	**223**	65.39

Baked on 3/1/2005

	(Color Standard 4)	Color"L"value
Set 2 SC-4-1	576	53.04
Set 2 SC-4-2	619	53.04
Set 2 SC-4-3	620	53.04
Set 2 SC-4-4	633	53.04
mean	**612**	53.04

exclude: too low

	(Color Standard 5)	Color"L"value
Set 2 SC-5-1	didn't make at all	didn't make at all
Set 2 SC-5-2		
Set 2 SC-5-3		
Set 2 SC-5-4		
mean	**#DIV/0!**	

Recorded by: | Date | Verified by: Elena A. Miller | Date

Set 4/1

(4/1/2005)

(Color Standard 4)		Color"L"value
SC-4-1	972	53.41
SC-4-2	1005	53.41
SC-4-3	981	53.41
SC-4-4	992	53.41
mean	**988**	53.41

Set 4/2

(4/12/2005)

(Color Standard 4)	
S4C4-1	740
S4C4-2	561
S4C4-3	638
S4C4-4	718
mean	**664**

(4/1/2005)

(Color Standard 5)		Color"L"value
SC-5-1	1239	43.93
SC-5-2	1400	43.93
SC-5-3	1231	43.93
SC-5-4	1215	43.93
mean	**1271**	43.93
	went to dryness	
	reconcentrated by J.J.	

(4/12/2005)

(Color Standard 5)	
S4C5-1	601
S4C5-2	742
S4C5-3	749
S4C5-4	629
mean	**680**

Basic Pie Crust, STD Colors 4 and 5, Set # 4 (Ground) April 01, 2005

	ID	L*	a*	b*	DE*
Standard		93.51	-0.93	1	
Tolerance +					
Tolerance -					
Sample 2	PIE CRUST, STD # 5, SET 4	43.93	14.53	31.68	60.32
Sample 1	PIE CRUST, STD # 4, SET 4	53.41	13.04	35.55	54.74

Basic Pie Crust, STD Colors 3 and 4, Set # 3 (Ground) March 01, 2005

	ID	L*	a*	b*	DE*
Standard		93.52	-0.94	0.99	
Tolerance +					
Tolerance -					
Sample 2	BASIC PIE CRUST, REPEAT STD COLOR # 4	53.04	13.25	34.15	54.22
Sample 1	BASIC PIE CRUST, REPEAT STD COLOR # 3	65.39	8.31	30.71	41.96

Basic Pie Crust, STD Colors 3 and 4, Set # 5 (Ground) April 12, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	0.99	
Tolerance +					
Tolerance -					
Sample 2	BASIC PIE CRUST COL STD # 4, SET 4	53.19	14.11	43.72	60.66
Sample 1	BASIC PIE CRUST COL STD # 3, SET 4	70.36	5.54	31.68	38.99

Set 5

(4/18/2005) (Color Standard 3)		(4/18/2005) Color"L"value
S5-SC3-1	113	70.36
S5-SC3-2	86	70.36
S5-SC3-3	93	70.36
S5-SC3-4	103	70.36
mean	**99**	70.36

(4/18/2005) (Color Standard 4)		(4/18/2005) Color"L"value
S5-SC4-1	781	53.19
S5-SC4-2	742	53.19
S5-SC4-3	764	53.19
S5-SC4-4	750	53.19
mean	**759**	53.19

Recorded by: | Date | Verified by: Elena A. Miller | Date

Basic Pie Crust, STD Colors between # 3 & 4 L value = 60.45 & 54.89 (Ground) April 19, 2005

Standard		93.56	-0.93	1.01	
Tolerance +					
Tolerance -					
Sample 16	BASIC PIE CRUST, STD COLOR, L=60.45	60.45	10.55	32.28	46.96
Sample 11	BASIC PIE CRUST, STD COLOR, L=64.89	64.89	8.57	31.03	42.58

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Egg white and Albumin (Ground) April 22, 2005

Standard		93.52	-0.93	1	
Tolerance +					
Tolerance -					
Sample 13	BASIC PIE CRUST, STD, SET1, L=60.08	60.08	10.5	31.6	46.75
Sample 18	BASIC PIE CRUST WITH EGG WHITE, SET1, L=60.02	60.02	11.28	32.53	47.6
Sample 31	BASIC PIE CRUST WITH ALBUMIN, SET1, L=60.76	60.76	11.37	32.96	47.39

Basic Pie Crust Recipe with Egg White

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 egg white (33.8 g)
2 Tablespoons of Water

Basic Pie Crust Recipe with Albumin

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Albumin (= 0.3% of flour weight)
3 Tablespoons of Water

Project No. Acrylamide

Book No. 1 TITLE Summary of pgs 12-25

It is clear that broad standard deviation in browning vs acrylamide level that statistically significant solutions to the question of acrylamide mitigation cannot be observed in the data, if all data is considered. There are times within a given day that reductions appear clear cut. Consequently a new plan is being explored. The results of a given day for some formulation are compared to a standard formulation sample prepared and extracted the same day.

Recorded by:	Date	Verified by:	Date
		Elena A. Miller	

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Vinegar and Citric Acid (Ground) April 28, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	0.97	
Tolerance +					
Tolerance -					
Sample 11	BAS PIE CR. W. CITRIC ACID, L VAL=59.58	59.58	11.47	34.75	49.48
Sample 9	BASIC PIE CR. W. VINEGAR, L VALUE=60.37	60.37	10.82	32.9	47.51
Sample 6	BASIC PIE CR., STD,SET 2, L VALUE=59.92	59.92	11.07	34.29	48.83

Basic Pie Crust Recipe with Citric Acid

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
0.63g of Ascorbic Acid (99%) (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Vinegar

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 Tablespoon of Vinegar
2 Tablespoons of Water

Made on 04/29/05

Basic Pie Crust Recipe with Egg White

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 egg white (36.8 g)
2 Tablespoons of Water

Basic Pie Crust Recipe with Egg Yolk

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 egg yolk (24.7 g)
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Egg White & Egg Yolk (Ground) April 29, 2005

Standard		93.54	-0.94	0.99	
Tolerance +					
Tolerance -					
Sample 18	BAS. PIE CRUST W. EGG WHITE, L VAL=73.42	73.42	5.28	26.89	33.38
Sample 3	BASIC PIE CRUST, STD, SET 3, L VAL=73.62	73.62	4.21	25.41	31.93
Sample 10	BAS. PIE CRUST W. EGG YOLK, L VAL=74.00	74	4.12	27.22	33.1

Acrylamide Levels in Piecrust: Effect of Additives
Same Day Comparison, Basic v Additives
Linear, Forced Zero Calibration

Basic (standard) 4/26/05	
Sample ID	Acrylamide ppb
basicstd-1-1	555
basicstd-1-2	549
basicstd-1-3	532
basicstd-1-4	527
mean	541

Albumin 4/26/05	
Sample ID	Acrylamide ppb
alb-1-1	583
alb-1-2	556
alb-1-3	617
alb-1-4	577
mean	583

Egg White 4/26/05	
Sample ID	Acrylamide ppb
eggwht-1-1	565
eggwht-1-2	570
eggwht-1-3	557
eggwht-1-4	566
mean	565

Basic (standard) 5/2/05	
Sample ID	Acrylamide ppb
basicstd-1-1	691
basicstd-1-2	623
basicstd-1-3	677
basicstd-1-4	674
mean	666

Citric Acid 5/2/05	
Sample ID	Acrylamide ppb
alb-1-1	323
alb-1-2	333
alb-1-3	327
alb-1-4	328
mean	328

Vinegar 5/2/05	
Sample ID	Acrylamide ppb
eggwht-1-1	597
eggwht-1-2	562
eggwht-1-3	582
eggwht-1-4	577
mean	580

Basic Pie Crust Recipe with Albumin

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Albumin (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Lecithin

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Lecithin (= 0.3% of flour weight)
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Albumin & Lecitin (Ground) May 16, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 5	BAS PIE CRUST, W. ALBUMIN, L VAL=72.82	72.82	6.03	28.88	35.42
Sample 4	BAS PIE CRUST, W. LECITIN, L VAL=72.13	72.13	5.83	27.9	35.04
Sample 2	BAS PIE CRUST, STD, L VAL=72.34	72.34	5.7	27.42	34.52

Basic (standard)	
5/18/05	
Sample ID	Acrylamide ppb
basicstd-3-1	152
basicstd-3-2	160
basicstd-3-3	162
basicstd-3-4	146
mean	**155**

Egg White	
5/18/05	
Sample ID	Acrylamide ppb
EggWht-3-1	79
EggWht-3-2	84
EggWht-3-3	76
EggWht-3-4	76
mean	**79**

Lecithin	
5/18/05	
Sample ID	Acrylamide ppb
Lec-2-1	95
Lec-2-2	91
Lec-2-3	81
Lec-2-4	85
mean	**88**

Basic Pie Crust Recipe with Ascorbic Acid

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Ascorbic Acid (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Sodium Metabisulfite

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Sodium Metabisulfite (= 0.3% of flour weight)
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Ascorbic Acid & Sodium Metabisulfite (Ground) May 20, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 3	BAS PIE CR, SODIUM METABISU, L VAL=72.62	72.62	6.01	29.86	36.31
Sample 2	BAS PIE CRUST, ASCORB ACID, L VAL=72.06	72.06	6.15	28.71	35.77
Sample 1	BAS PIE CRUST, STD, L VAL=72.26	72.26	6	27.62	34.77

Basic (standard)	
5/25/05	
Sample ID	Acrylamide ppb
basicstd-4-1	218
basicstd-4-2	212
basicstd-4-3	202
basicstd-4-4	217
mean	**212**

Ascorbic Acid	
5/25/05	
Sample ID	Acrylamide ppb
Ascorbic-1-1	61
Ascorbic-1-2	56
Ascorbic-1-3	56
Ascorbic-1-4	61
mean	**59**

Metabisulfite	
5/25/05	
Sample ID	Acrylamide ppb
Metabilsulfite-1-1	235
Metabilsulfite-1-2	219
Metabilsulfite-1-3	218
Metabilsulfite-1-4	238
mean	**228**

Recorded by: | Date | Verified by: Elena A. Miller | Date

Basic Pie Crust Recipe with Tryptophan- 99%

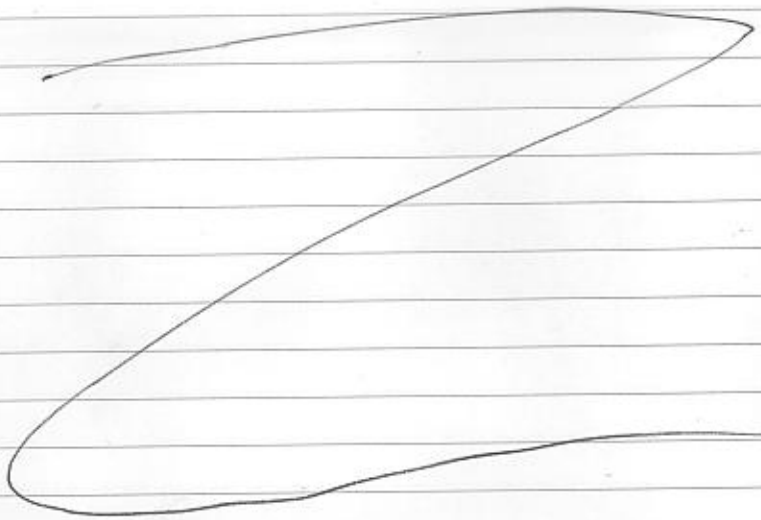
1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Tryptophan (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Gelatin, granular

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Gelatin (= 0.3% of flour weight)
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Tryptophan & Gelatin (Ground) May 23, 2005

	ID	L*	a*	b*	DE*
Standard		93.55	-0.93	0.99	
Tolerance +					
Tolerance -					
Sample 3	BAS PIE CRUST, W. GELATIN, L VAL=72.52	72.52	5.61	28.98	35.61
Sample 2	BAS PIE CR, W. TRYPTOPHAN, L VAL=72.94	72.94	5.32	27.84	34.42
Sample 1	BAS PIE CRUST, STD, L VAL=72.32	72.32	5.42	28.39	35.24



Recorded by: | Date | Verified by: Elena A. Miller | Date

Basic Pie Crust Recipe with Citric Acid Anhydrous

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
0.45g of Ascorbic Acid (99%)
3 Tablespoons of Water

Basic Pie Crust Recipe with Skim Milk

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
3 Tablespoons of Skim Milk

Basic Pie Crust Recipe with Vegetable Oil

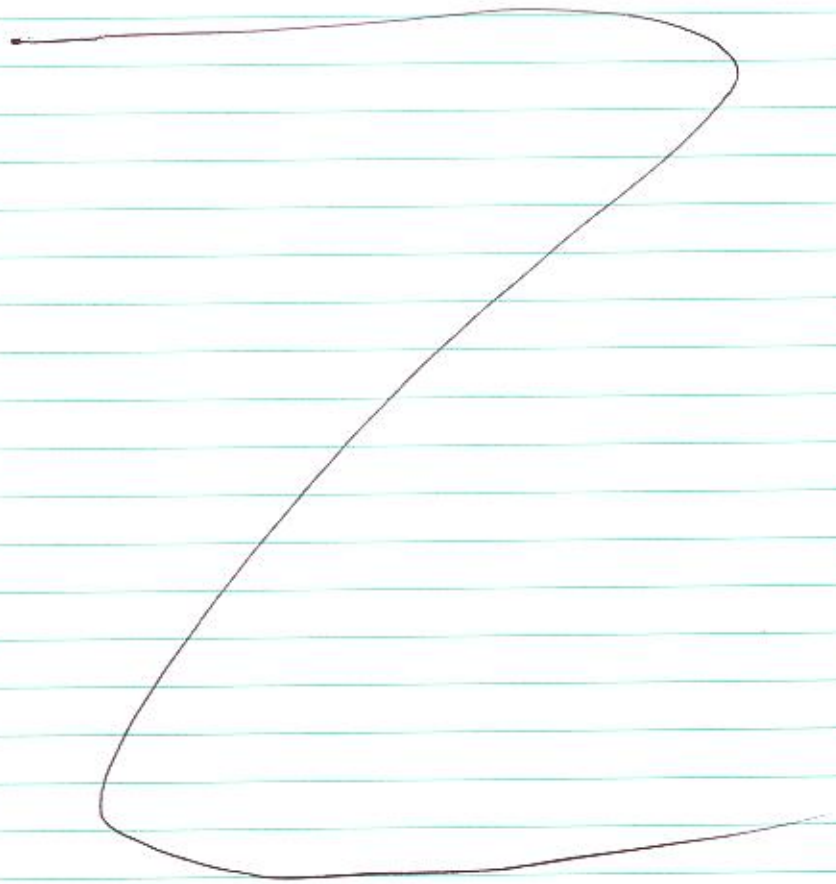
1 1/3 cup of all-purpose flour
94 g of Vegetable Oil
½ teaspoon salt
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Milk, Citric Acid & Vegetable Oil (Ground) May 25, 2005

	ID	L*	a*	b*	DE*
Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 4	BAS PIE CR W. VEGET OIL, L VAL=71.19	71.19	4.75	26.78	34.59
Sample 3	BAS PIE CR W. CITRIC ACID, L VAL=71.72	71.72	6.25	28.83	36.08
Sample 2	BAS PIE CR W. MILK, L VAL=71.43	71.43	6.53	28.85	36.33
Sample 1	BAS PIE CR, STD, L VAL=71.62	71.62	6.22	28.96	36.24

color	basic pie crust	with citric acid	with skim milk	with vegetable oil
71.62	164	103	39	35
71.62	177	106	49	34
71.62	160	109	47	28
71.62	163	96	50	32

color	basic pie crust	with gelatin	with tryptophan
72.32	112	76	49
72.32	113	72	55
72.32	111	80	48
72.32	123	74	50



Made on August 1st, 05

Basic Pie Crust Recipe with Lecithin

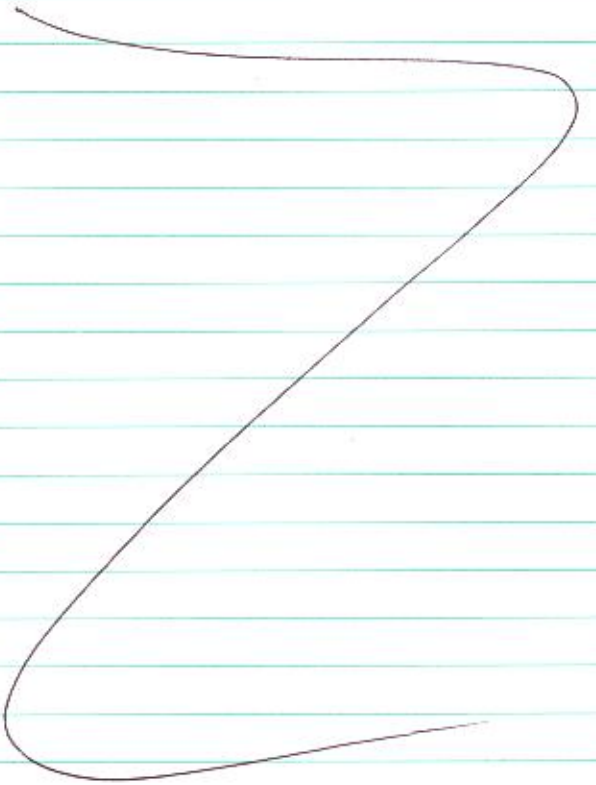
1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Lecithin (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Ascorbic Acid

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Ascorbic Acid (= 0.3% of flour weight)
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Ascorbic Acid & Lecitin (Ground) August 01, 2005

	ID	L*	a*	b*	DE*
Standard		93.54	-0.93	0.99	
Tolerance +					
Tolerance -					
Sample 3	BASIC PIE CRUST, LECITIN, L=72.59	72.59	5.57	28.2	34.95
Sample 2	BASIC PIE CRUST, ASCORBIC ACID, L=72.37	72.37	5.79	29.88	36.44
Sample 1	BASIC PIE CRUST STD, L=72.62	72.62	5.61	28.11	34.87



Made on August 3, 2005

Basic Pie Crust Recipe with Gelatin, granular

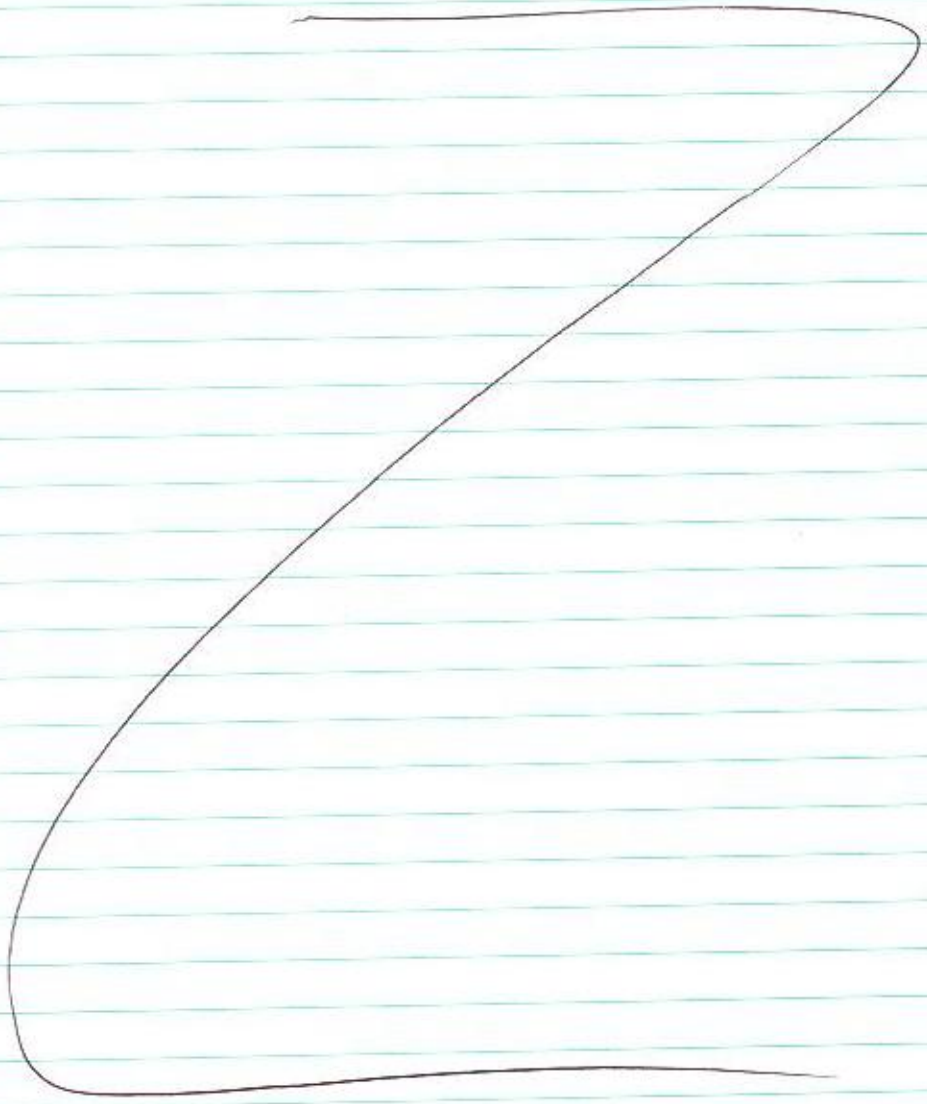
1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Gelatin (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Vinegar

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
1 Tablespoon of Vinegar
2 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Vinegar & Gelatin (Ground) August 03, 2005

Standard		93.54	-0.94	0.99	
Tolerance +					
Tolerance -					
Sample 3	BASIC PIE CRUST, VINEGAR, L=72.13	72.13	6.26	29.83	36.63
Sample 2	BASIC PIE CRUST,GELATIN, L=72.40	72.4	5.63	27.34	34.42
Sample 1	BASIC PIE CRUST, STD, L=72.24	72.24	5.69	28.2	35.18



Made on August 5, 2005

Basic Pie Crust Recipe with Skim Milk

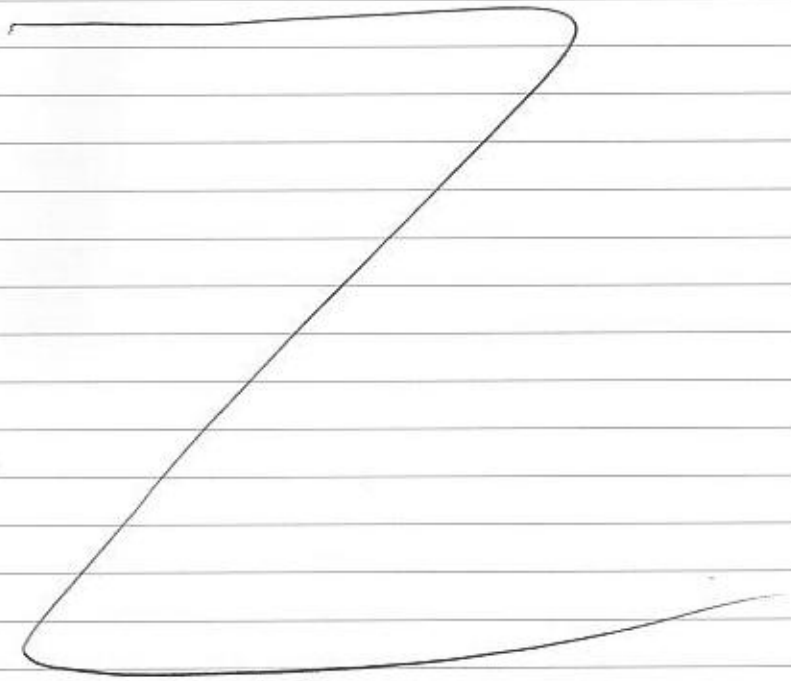
1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
3 Tablespoons of Skim Milk

Basic Pie Crust Recipe with Vegetable Oil

1 1/3 cup of all-purpose flour
94 g of Vegetable Oil
½ teaspoon salt
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Milk & Veg. Oil (Ground) August 05, 2005

Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 3	BASIC PIE CRUST, VEG OIL, 72.78	72.78	3.38	25.86	32.67
Sample 2	BASIC PIE CRUST, MILK, L=72.58	72.58	6.33	28.64	35.43
Sample 1	BASIC PIE CRUST, STD, L=72.30	72.3	5.69	28.44	35.32



Made on August 8, 2005

Basic Pie Crust Recipe with Tryptophan- 99%

1 1/3 cup of all-purpose flour (210g)
½ cup Crisco Shortening
½ teaspoon salt
0.63 g of Tryptophan (= 0.3% of flour weight)
3 Tablespoons of Water

Basic Pie Crust Recipe with Citric Acid Anhydrous

1 1/3 cup of all-purpose flour
½ cup Crisco Shortening
½ teaspoon salt
0.63g of Citric Acid (= 0.3% of flour weight)
3 Tablespoons of Water

!!! New Approach!!! - Basic Pie Crust: STD Color, w. Tryptophan & Citric Acid (Ground) August 08, 2005

Standard		93.53	-0.93	1	
Tolerance +					
Tolerance -					
Sample 3	BASIC PIE CRUST, CITRIC ACID, L=72.24	72.24	5.53	27.86	34.88
Sample 2	BASIC PIE CRUST, TRYPTOPHAN, L=72.14	72.14	6.03	28.13	35.25
Sample 1	BASIC PIE CRUST, STD, L=72.34	72.34	5.9	28.86	35.67