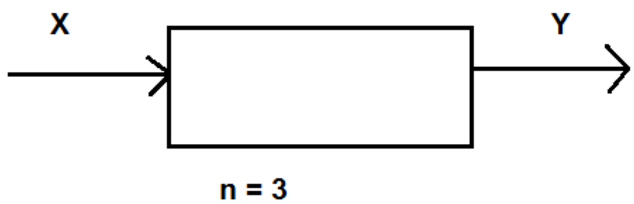
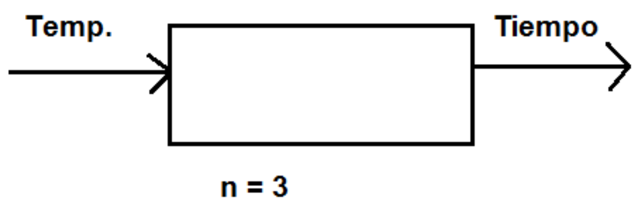
APENDICES

APÉNDICE A

Diseñó Experimental

Modelo en el diseño Experimental.





Modelo en el diseño Experimental.

Yij = u + Tj + Eij

Tabla de datos, Procedimiento de varianza, modelo matemático.

tiempo	85°C	80°C	90°C
0	29	29	30
2	35	35	36
4	45	43	45
6	53	53	55
8	65	65	65
10	72	75	74
12	75	82	83
14	80	85	85
16	72	75	87
18	67	71	90
20	64	67	83
22	62	64	76
24	60	60	71
26	58	58	67
28	55	55	63
30	54	53	60

Procedimiento de Varianza.

ANOVA unidireccional: C6 vs. C7

Fuente	GL	SC	MC	F	P
C7	14	1342,0	95,9	5,33	0,329
Error	1	18,0	18,0		
Total	15	1360,0			

S = 4,243   R-cuad. = 98,68%   R-cuad.(ajustado) = 80,15%

Gráficas de residuos para C6

ANOVA unidireccional: C6 vs. C8

Fuente	GL	SC	MC	F	P
C8	13	1054	81	0,53	0,809
Error	2	306	153		
Total	15	1360			

S = 12,37   R-cuad. = 77,50%   R-cuad. (Ajustado) = 0,00%

Gráficas de residuos para C6

ANOVA unidireccional: C6 vs. C9

Fuente	**GL**	**SC**	**MC**	**F**	**P**
C9	**14**	**1328,0**	**94,9**	**2,96**	**0,429**
Error	**1**	**32,0**	**32,0**		
Total	**15**	**1360,0**			

S = 5,657   R-cuad. = 97,65%   R-cuad. (Ajustado) = 64,71%

APÉNDICE B

Las pruebas de la formulación de la pulpa de fruta se iniciaron con las proporciones que se muestran en la tabla 2.4.1.1:

FORMULACIÓN 1

INGREDIENTE	PORCENTAJE	GRAMOS
Naranjilla	35	55
Mango	35	55
Agua	30	50
Total antes de escaldar	100	160

157---100%　　　157---100

55------x　　　50------x

FORMULACIÓN 2

INGREDIENTE	PORCENTAJE	GRAMOS
Naranjilla	35	55
mango	35	55
AGUA	30	50
SUMATORIA	100	160

$$\% \text{ de Rendimiento} = \frac{\text{Peso final}}{\text{Peso inicial}} * 100 \quad \text{Ec. 1}$$

% de rendimiento= (134.7/151)*100= 89.2 para naranjilla escaldada después de pelar

%rendimiento = (148.4/157)*100= 94.52 para naranjilla escaldada antes de pelar

% de rendimiento= (93/120)*100= 77.1 para tomatillo escaldado después de pelar

% de rendimiento=(95.5/123)100=77.6 para tomatillo escaldado antes de pelar

APÉNDICE C

PRUEBA DE EVALUACIÓN SENSORIAL, FORMATO Y RESULTADOS.

Nombre______________________________ Fecha: ____________

PRODUCTO: PULPA DE FRUTAS COMBINADAS

Pruebe las muestras de limonada que se les presente e indique según la escala su opinión sobre ellas

ESCALA	275	809	996	775	887
Me gusta mucho					
Me gusta					
Me gusta ligeramente					
Ni me gusta ni me disgusta					
Me disgusta					
Me disgusta mucho					

Comentarios: ____

____

MUCHAS GRACIAS

DONDE:

275: mora con frutilla
809: naranjilla con mango
996: mango con papaya
775: tomatillo con frutilla
887: Durazno con mango

De donde se escogieron las muestras 809 y 775 con mayor aceptabilidad la encuesta se realice a amas de casa, profesores, y demás personas en un total de 20 aproximadamente

	¿Acepta el producto?	
No de jueces	**Si**	**No**
1	X	
2	X	
3		X
4		X
6	X	
7	X	
8	X	
9		X
10	X	
11	X	
12	X	
13	X	
14	X	
15		X
16	X	
17	X	
18	X	
19	X	
20	X	
21	X	
22	X	
23		X
24	X	
25	X	
26	X	
27	X	
28	X	
29	X	
30	X	
31	X	
32	X	
33	X	
34	X	
35	X	

$$\textbf{\% de aceptación} = \frac{\textbf{Total de respuestas positivas}}{\textbf{No total de jueces}} * 100 \quad \textbf{Ec. 2}$$

$$\% \text{ de aceptación} = \frac{30}{35} * 100 = 85.71\ \%$$

$$\% \text{ de rechazo} = \frac{5}{35} * 100 = 14.28\ \%$$

APÉNDICE D

Informe de laboratorio para recuento de mohos en pulpa de frutas.

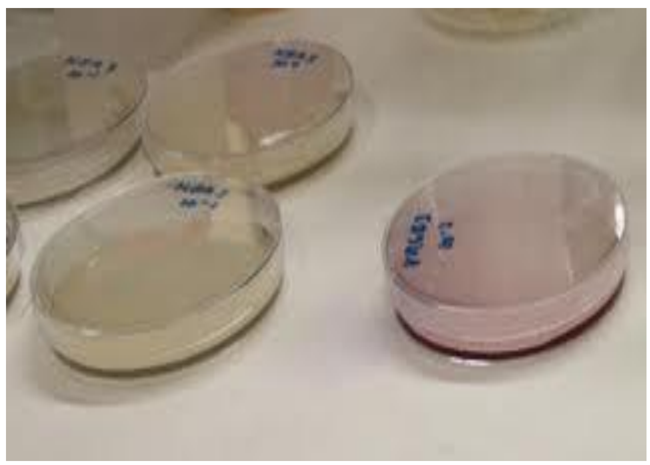
Recuento de mohos y Levaduras.

Límites Permisibles

Requisitos	**Mínimo**	**Máximo**
Recuento de mohos y levaduras UPC/g	1000	3000

Muestras	**UPC/g**
Agua de Peptona 10^{0}	Incontables
Agua de Peptona 10^{-1}	257
Agua Peptona 10^{-2}	21

En la pulpa de fruta se pudo observar crecimiento de mohos y levaduras utilizando un medio de cultivo general (PDA). En donde se enriqueció la muestra en agua de peptona. Se procedió a sembrar en masa utilizando como inhibidor bacteriano Acido tartarico al 1 %. Para acidificar el medio y tener un PH optimo de crecimiento de 3,0 – 4,0



APÉNDICE E

Tablas para Pasteurización de valores z = 10 °F y z = 18 °F

TABLE 2.5

f_h/U Relationships when z = 10°F

	Values of g when j of cooling curve is								
f_h/U	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
0.20	2.68-05	2.78-05	2.88-05	2.98-05	3.07-05	3.17-05	3.27-05	3.36-05	3.46-05
0.30	8.40-04	9.39-04	1.04-03	1.14-03	1.24-03	1.34-03	1.43-03	1.53-03	1.63-03
0.40	5.84-03	6.51-03	7.18-03	7.85-03	8.53-03	9.20-03	9.87-03	1.05-02	1.12-02
0.50	2.01-02	2.21-02	2.40-02	2.60-02	2.79-02	2.99-02	3.18-02	3.38-02	3.57-02
0.60	4.73-02	5.11-02	5.49-02	5.87-02	6.25-02	6.63-02	7.01-02	7.39-02	7.77-02
0.70	8.85-02	9.44-02	1.00-01	1.06-01	1.12-01	1.18-01	1.24-01	1.30-01	1.36-01
0.80	0.143	0.151	0.159	0.167	0.175	0.183	0.191	0.199	0.207
0.90	0.208	0.218	0.228	0.238	0.248	0.258	0.268	0.278	0.288
1.00	0.282	0.294	0.305	0.317	0.329	0.340	0.352	0.364	0.376
2.00	1.14	1.17	1.19	1.21	1.24	1.26	1.29	1.31	1.33
3.00	1.83	1.88	1.92	1.97	2.01	2.05	2.10	2.14	2.19
4.00	2.33	2.41	2.48	2.55	2.63	2.70	2.77	2.85	2.92
5.00	2.71	2.81	2.92	3.03	3.14	3.24	3.35	3.46	3.57
6.00	3.01	3.15	3.29	3.43	3.57	3.72	3.86	4.00	4.14
7.00	3.25	3.43	3.61	3.78	3.96	4.13	4.31	4.49	4.66
8.00	3.47	3.68	3.89	4.10	4.30	4.51	4.72	4.93	5.14
9.00	3.67	3.90	4.14	4.38	4.62	4.85	5.09	5.33	5.57
10.00	3.84	4.11	4.38	4.64	4.91	5.17	5.44	5.70	5.97
15.00	4.60	4.97	5.35	5.72	6.09	6.47	6.84	7.21	7.59
20.00	5.22	5.67	6.12	6.57	7.01	7.46	7.91	8.35	8.80
25.00	5.78	6.27	6.77	7.27	7.77	8.27	8.76	9.26	9.76
30.00	6.27	6.81	7.34	7.88	8.41	8.95	9.48	10.02	10.55
35.00	6.72	7.29	7.85	8.41	8.98	9.54	10.10	10.67	11.23
40.00	7.14	7.72	8.31	8.89	9.48	10.06	10.65	11.23	11.82
45.00	7.52	8.12	8.72	9.33	9.93	10.53	11.13	11.73	12.33
50.00	7.87	8.49	9.10	9.72	10.34	10.95	11.57	12.18	12.80
60.00	8.51	9.15	9.78	10.42	11.06	11.69	12.33	12.97	13.60
70.00	9.07	9.72	10.37	11.02	11.68	12.33	12.98	13.63	14.28
80.00	9.56	10.23	10.89	11.55	12.22	12.88	13.55	14.21	14.88
90.00	10.0	10.7	11.4	12.0	12.7	13.4	14.1	14.7	15.4
100.00	10.4	11.1	11.8	12.5	13.1	13.8	14.5	15.2	15.9
150.00	11.9	12.6	13.4	14.1	14.8	15.5	16.3	17.0	17.7
200.00	13.0	13.7	14.5	15.2	16.0	16.8	17.5	18.3	19.0
250.00	13.7	14.5	15.3	16.1	16.9	17.7	18.5	19.3	20.1
300.00	14.3	15.2	16.0	16.8	17.7	18.5	19.3	20.1	21.0
350.00	14.8	15.7	16.5	17.4	18.3	19.1	20.0	20.9	21.7
400.00	15.2	16.1	17.0	17.9	18.8	19.7	20.6	21.5	22.4
450.00	15.5	16.5	17.4	18.3	19.3	20.2	21.1	22.1	23.0
500.00	15.8	16.8	17.8	18.7	19.7	20.6	21.6	22.6	23.5
600.00	16.3	17.4	18.4	19.4	20.4	21.4	22.4	23.4	24.5
700.00	16.8	17.8	18.9	19.9	21.0	22.1	23.1	24.2	25.3
800.00	17.1	18.2	19.3	20.4	21.5	22.6	23.7	24.8	25.9
900.00	17.4	18.5	19.7	20.8	22.0	23.1	24.3	25.4	26.6
999.99	17.7	18.8	20.0	21.2	22.4	23.6	24.7	25.9	27.1

From Stumbo, C.R. 1973. *Thermobacteriology in Food Processing*. 2nd ed. Academic Press, New York, p. 256. With permission.

TABLE 2.6

f_h/U Relationships when z = 18°F

	Values of g when j of cooling curve is								
f_h/U	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
0.20	4.09-05	4.42-05	4.76-05	5.09-05	5.43-05	5.76-05	6.10-05	6.44-05	6.77-05
0.30	2.01-03	2.14-03	2.27-03	2.40-03	2.53-03	2.66-03	2.79-03	2.93-03	3.06-03
0.40	1.33-02	1.43-02	1.52-02	1.62-02	1.71-02	1.80-02	1.90-02	1.99-02	2.09-02
0.50	4.11-02	4.42-02	4.74-02	5.06-02	5.38-02	5.70-02	6.02-02	6.34-02	6.65-02
0.60	8.70-02	9.43-02	1.02-01	1.09-01	1.16-01	1.23-01	1.31-01	1.38-01	1.45-01
0.70	0.150	0.163	0.176	0.189	0.202	0.215	0.228	0.241	0.255
0.80	0.226	0.246	0.267	0.287	0.308	0.328	0.349	0.369	0.390
0.90	0.313	0.342	0.371	0.400	0.429	0.458	0.487	0.516	0.545
1.00	0.408	0.447	0.485	0.523	0.561	0.600	0.638	0.676	0.715
2.00	1.53	1.66	1.80	1.93	2.07	2.21	2.34	2.48	2.61
3.00	2.63	2.84	3.05	3.26	3.47	3.68	3.89	4.10	4.31
4.00	3.61	3.87	4.14	4.41	4.68	4.94	5.21	5.48	5.75
5.00	4.44	4.76	5.08	5.40	5.71	6.03	6.35	6.67	6.99
6.00	5.15	5.52	5.88	6.25	6.61	6.98	7.34	7.71	8.07
7.00	5.77	6.18	6.59	7.00	7.41	7.82	8.23	8.64	9.05
8.00	6.29	6.75	7.20	7.66	8.11	8.56	9.02	9.47	9.93
9.00	6.76	7.26	7.75	8.25	8.74	9.24	9.74	10.23	10.73
10.00	7.17	7.71	8.24	8.78	9.32	9.86	10.39	10.93	11.47
15.00	8.73	9.44	10.16	10.88	11.59	12.31	13.02	13.74	14.45
20.00	9.83	10.69	11.55	12.40	13.26	14.11	14.97	15.82	16.68
25.00	10.7	11.7	12.7	13.6	14.6	15.6	16.5	17.5	18.4
30.00	11.5	12.5	13.6	14.6	15.7	16.8	17.8	18.9	19.9
35.00	12.1	13.3	14.4	15.5	16.7	17.8	18.9	20.0	21.2
40.00	12.8	13.9	15.1	16.3	17.5	18.7	19.9	21.1	22.3
45.00	13.3	14.6	15.8	17.0	18.3	19.5	20.8	22.0	23.2
50.00	13.8	15.1	16.4	17.7	19.0	20.3	21.6	22.8	24.1
60.00	14.8	16.1	17.5	18.9	20.2	21.6	22.9	24.3	25.7
70.00	15.6	17.0	18.4	19.9	21.3	22.7	24.1	25.6	27.0
80.00	16.3	17.8	19.3	20.8	22.2	23.7	25.2	26.7	28.1
90.00	17.0	18.5	20.1	21.6	23.1	24.6	26.1	27.6	29.2
100.00	17.6	19.2	20.8	22.3	23.9	25.4	27.0	28.5	30.1
150.00	20.1	21.8	23.5	25.2	26.8	28.5	30.2	31.9	33.6
200.00	21.7	23.5	25.3	27.1	28.9	30.7	32.5	34.3	36.2
250.00	22.9	24.8	26.7	28.6	30.5	32.4	34.3	36.2	38.1
300.00	23.8	25.8	27.8	29.8	31.8	33.7	35.7	37.7	39.7
350.00	24.5	26.6	28.6	30.7	32.8	34.9	37.0	39.0	41.1
400.00	25.1	27.2	29.4	31.5	33.7	35.9	38.0	40.2	42.3
450.00	25.6	27.8	30.0	32.3	34.5	36.7	38.9	41.2	43.4
500.00	26.0	28.3	30.6	32.9	35.2	37.5	39.8	42.1	44.4
600.00	26.8	29.2	31.6	34.0	36.4	38.8	41.2	43.6	46.0
700.00	27.5	30.0	32.5	35.0	37.5	39.9	42.4	44.9	47.4
800.00	28.1	30.7	33.3	35.8	38.4	40.9	43.5	46.0	48.6
900.00	28.7	31.3	34.0	36.6	39.2	[illegible]	44.4	47.0	49.7
999.99	29.3	31.9	34.6	37.3	39.9	42.6	45.3	47.9	50.6

From Stumbo, C.R. 1973. *Thermobacteriology in Food Processing*. 2nd ed. Academic Press, New York, p. 260. With permission.

APÉNDICE F

Determinación del contenido final de Vitamina "C" en las pulpas de frutas.

Factores de Calidad

Table 9.15 f_h/U vs. g Table Used for Thermal Process Calculation by Stumbo's Procedure

	z = 60		z = 70		z = 80		z = 90	
f_h/U	$g_{j=1}$	$\frac{\Delta g}{\Delta j}$	$g_{j=1}$	$\frac{\Delta g}{\Delta j}$	$g_{j=1}$	$\frac{\Delta g}{\Delta j}$	$g_{j=1}$	$\frac{\Delta g}{\Delta j}$
0.2	0.00018	0.00015	0.000218	0.000134	0.000253	0.00017	0.000289	0.000208
0.3	0.0085	0.000475	0.0101	0.0062	0.000253	0.00017	0.0134	0.0097
0.4	0.0583	0.032	0.0689	0.0421	0.0118	0.00775	0.0919	0.0661
0.5	0.185	0.1025	0.0219	0.0134	0.0802	0.0545	0.292	0.208
0.6	0.401	0.2225	0.474	0.292	0.255	0.17	0.632	0.452
0.7	0.699	0.3875	0.828	0.510	0.552	0.3675	0.101	0.791
0.8	0.064	0.595	0.263	0.777	0.963	0.6425	0.678	1.205
0.9	1.482	0.8325	1.76	1.08	1.469	0.9775	2.34	1.68
1.0	1.94	1.075	2.30	1.42	2.05	1.45	3.06	2.19
2.0	7.04	4.025	8.35	5.19	2.68	1.775	11.03	7.88
3.0	11.63	6.65	13.73	8.58	9.68	6.475	18.0	12.8
4.0	15.40	9.00	18.2	11.4	12.92	8.65	23.6	16.7
5.0	18.70	10.75	21.9	13.7	15.85	10.65	28.2	19.7
6.0	21.40	12.50	25.1	15.6	18.5	12.5		
7.0	23.80	13.75	27.9	17.2	20.9	14.0		
8.0	26.00	15.00	30.3	18.6	23.1	15.5		
9.0	27.90	16.00	32.5	19.8	25.1	16.75		

Source: Based on f_h/U vs. g tables in Stumbo, C.R. 1973. *Thermobacteriology in Food Processing*, 2nd ed. Academic Press, New York.

APÉNDICE G

Tablas de coeficientes para las ecuaciones físicas de cp, ,K para agua, azúcar y hielo.

Table A.2.9 Coefficients to Estimate Food Properties

Property	Component	Temperature function	Standard error	Standard % error
k (W/[m °C])	Protein	$k = 1.7881 \times 10^{-1} + 1.1958 \times 10^{-3}T - 2.7178 \times 10^{-6}T^2$	0.012	5.91
	Fat	$k = 1.8071 \times 10^{-1} - 2.7604 \times 10^{-3}T - 1.7749 \times 10^{-7}T^2$	0.0032	1.95
	Carbohydrate	$k = 2.0141 \times 10^{-1} + 1.3874 \times 10^{-3}T - 4.3312 \times 10^{-6}T^2$	0.0134	5.42
	Fiber	$k = 1.8331 \times 10^{-1} + 1.2497 \times 10^{-3}T - 3.1683 \times 10^{-6}T^2$	0.0127	5.55
	Ash	$k = 3.2962 \times 10^{-1} + 1.4011 \times 10^{-3}T - 2.9069 \times 10^{-6}T^2$	0.0083	2.15
	Water	$k = 5.7109 \times 10^{-1} + 1.7625 \times 10^{-3}T - 6.7036 \times 10^{-6}T^2$	0.0028	0.45
	Ice	$k = 2.2196 - 6.2489 \times 10^{-3}T + 1.0154 \times 10^{-4}T^2$	0.0079	0.79
α (m^2/s)	Protein	$\alpha = 6.8714 \times 10^{-2} + 4.7578 \times 10^{-4}T - 1.4646 \times 10^{-6}T^2$	0.0038	4.50
	Fat	$\alpha = 9.8777 \times 10^{-2} - 1.2569 \times 10^{-4}T - 3.8286 \times 10^{-8}T^2$	0.0020	2.15
	Carbohydrate	$\alpha = 8.0842 \times 10^{-2} + 5.3052 \times 10^{-4}T - 2.3218 \times 10^{-6}T^2$	0.0058	5.84
	Fiber	$\alpha = 7.3976 \times 10^{-2} + 5.1902 \times 10^{-4}T - 2.2202 \times 10^{-6}T^2$	0.0026	3.14
	Ash	$\alpha = 1.2461 \times 10^{-1} + 3.7321 \times 10^{-4}T - 1.2244 \times 10^{-6}T^2$	0.0022	1.61
	Water	$\alpha = 1.3168 \times 10^{-1} + 6.2477 \times 10^{-4}T - 2.4022 \times 10^{-6}T^2$	0.0022×10^{-6}	1.44
	Ice	$\alpha = 1.1756 - 6.0833 \times 10^{-3}T + 9.5037 \times 10^{-5}T^2$	0.0044×10^{-6}	0.33
ρ (kg/m^3)	Protein	$\rho = 1.3299 \times 10^3 - 5.1840 \times 10^{-1}T$	39.9501	3.07
	Fat	$\rho = 9.2559 \times 10^2 - 4.1757 \times 10^{-1}T$	4.2554	0.47
	Carbohydrate	$\rho = 1.5991 \times 10^3 - 3.1046 \times 10^{-1}T$	93.1249	5.98
	Fiber	$\rho = 1.3115 \times 10^3 - 3.6589 \times 10^{-1}T$	8.2687	0.64
	Ash	$\rho = 2.4238 \times 10^3 - 2.8063 \times 10^{-1}T$	2.2315	0.09
	Water	$\rho = 9.9718 \times 10^2 + 3.1439 \times 10^{-3}T - 3.7574 \times 10^{-3}T^2$	2.1044	0.22
	Ice	$\rho = 9.1689 \times 10^2 - 1.3071 \times 10^{-1}T$	0.5382	0.06
c_p (kJ/[kg °C])	Protein	$c_p = 2.0082 + 1.2089 \times 10^{-3}T - 1.3129 \times 10^{-6}T^2$	0.1147	5.57
	Fat	$c_p = 1.9842 + 1.4733 \times 10^{-3}T - 4.8008 \times 10^{-6}T^2$	0.0236	1.16
	Carbohydrate	$c_p = 1.5488 + 1.9625 \times 10^{-3}T - 5.9399 \times 10^{-6}T^2$	0.0986	5.96
	Fiber	$c_p = 1.8459 + 1.8306 \times 10^{-3}T - 4.6509 \times 10^{-6}T^2$	0.0293	1.66
	Ash	$c_p = 1.0926 + 1.8896 \times 10^{-3}T - 3.6817 \times 10^{-6}T^2$	0.0296	2.47
	Water[a]	$c_p = 4.0817 - 5.3062 \times 10^{-3}T + 9.9516 \times 10^{-4}T^2$	0.0988	2.15
	Water[b]	$c_p = 4.1762 - 9.0864 \times 10^{-5}T + 5.4731 \times 10^{-6}T^2$	0.0159	0.38
	Ice	$c_p = 2.0623 + 6.0769 \times 10^{-3}T$		

Source: Choi and Okos (1986).

[a]For the temperature range of −40 to 0°C.

[b]For the temperature range of 0 to 150°C.

Fuente: Choi y Okos M. R. Physical and Chemical Properties of Food. 1986

APÉNDICE H

Graficas de P y R para el cálculo de Fourier

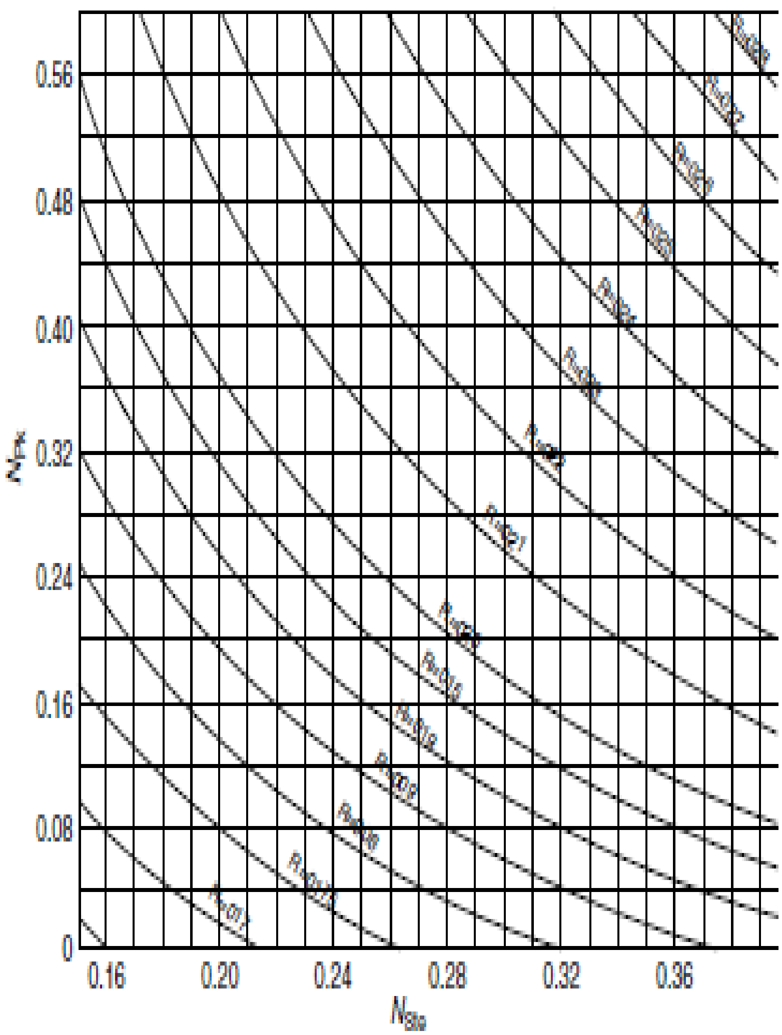


FIGURE 6.11 Chart showing the Planck's number vs. the Stefan number for determination of different values of the empirical modification *P*. (From Cleland, A.C. and Earle, R.L. 1982. *Int. J. Refrig.* 5: 134–140. With permission.)

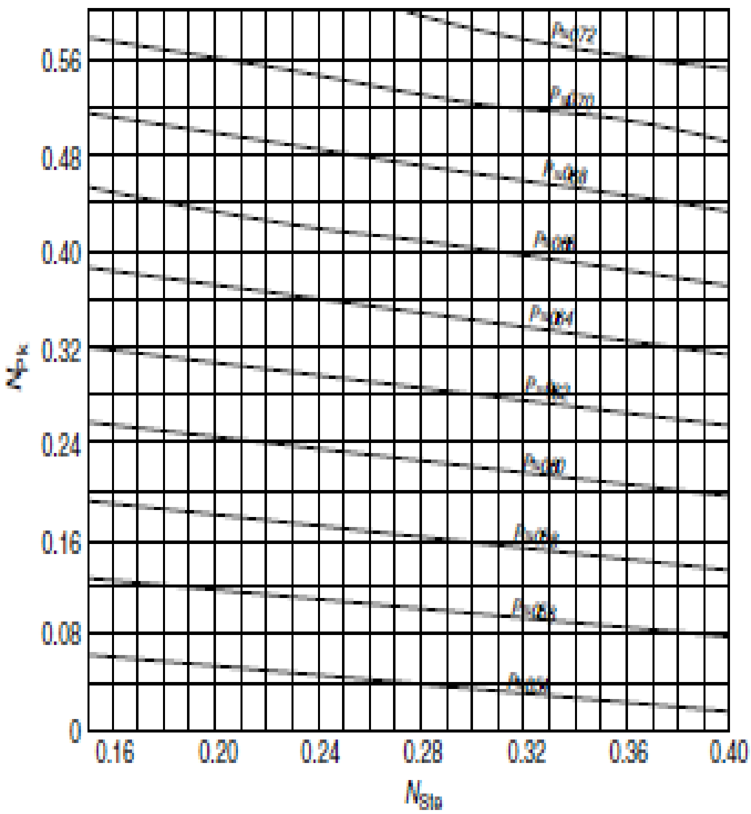


FIGURE 6.10 Chart showing the Planck number vs. the Stefan number for determination of different values of the empirical modification *P*. (From Cleland, A.C. and Earle, R.L. 1982. *Int. J. Refrig.* 5: 134–140. With permission.)

APÉNDICE I

VALORES DE w1 y w2

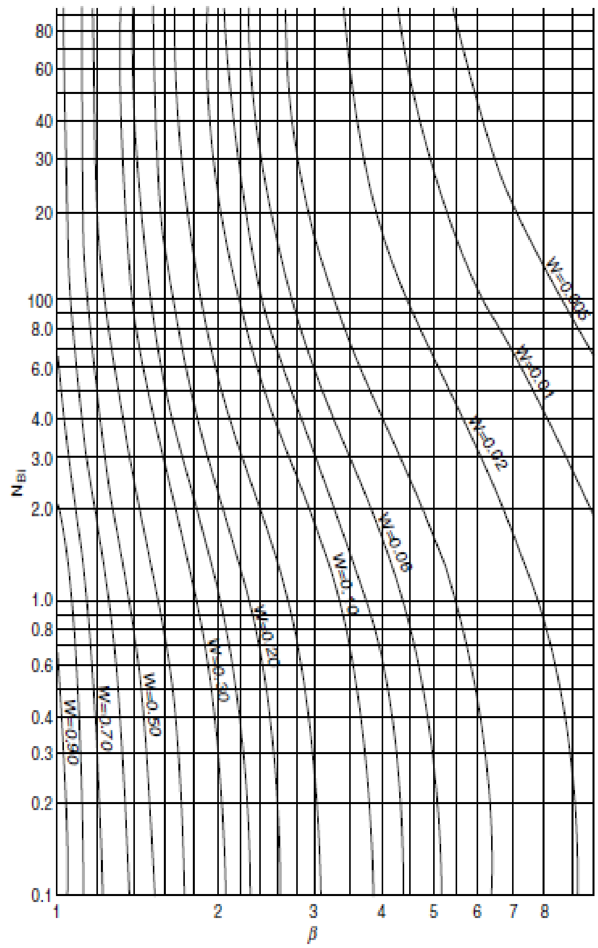


FIGURE 6.12 Chart showing the Biot number vs. the shape factor for determination of different values of *W*. (From Cleland, A.C. and Earle, R.L. 1982. *Int. J. Refrig.* 5: 134–140. With permission.)

APÉNDICE J

Plano 1. Diseño de la planta propuesta