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RHEOLOGICAL PROPERTIES OF CHILEAN FOOD

PROPIEDADES REOLÓGICAS DE ALIMENTOS CHILENOS

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DEDICATION

To Patricia del Carmen Bravo Rivera with all my love.

E. Castro

DEDICATORIA

Dedicado a Patricia del Carmen Bravo Rivera con todo mi amor

E. Castro

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Thanks to Constanza Barahona for your cooperation in this work.
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NOMENCLATURE
NOMENCLATURA

k, K	: Consistency coeficcient, Pas^n
	: Coeficiente de consistencia, Pas^n
G'	: Storage modulus
	: Módulo de almacenamiento
G''	: Loss modulus
	: Módulo de pérdida
G^X	: Complex Modulus
	: Módulo complejo
n	: Flow behavior index, dimensionless
	: índice de comportamiento de flujo, adimensional
R	: Correlation coeficcient
	: Coeficiente de correlación
R^2	: Regression coefficient
	: Coeficiente de regresión
t_c	: Thermal treatment
	: Tratamiento térmico
T	: Temperature , °C, °F, K
	: Tempertaura, °C, °F, K
w	: Frecuency, rad/s
	: Frecuencia, rad/s
$\dot{\gamma}$	: Shear rate, s^{-1}
	: Velocidad de deformación en cizalla, s^{-1}
η	: Apparent viscosity, Pas
	: Viscosidad aparente, Pas
μpl	: Plastic viscosity, Pas
	: Viscosidad plástica, Pas
σ	: Shear strees, Pa
	: Esfuerzo de cizalla, Pa
σ_o	: Yield stress, Pa
	: Umbral de fluencia, Pa

INTRODUCTION

The rheological data of chilean food products are very useful because for the design of equipment process and quality assurance.

This unique collection of data is from my undergraduate and master students works in the field of Food Science and Food Engineering and in solving problems to obtain their grade of title.

The relationship between $\sigma = \sigma (\dot{\gamma})$ was determined by means of simple approximation, approximation to Power Law (Newtonian method) and Krieger for static rheology.

Rheological properties presented in this work have been collected by using an Haake RV-2 (Type rotovisco concentric cylinder) viscosimeter with a Haake FK with cooling system termoregulated bath.

Viscoelastic data from chilean food are presented.

All data presented in this publication were the media of three measures.

INTRODUCCIÓN

Los datos reológicos de productos alimenticios chilenos son de gran utilidad para el diseño de equipos, procesos y calidad.

Esta serie de datos proviene de memorias y tesis realizadas en el campo de la ciencia e Ingeniería en Alimentos bajo mi dirección y estudiando los problemas presentados.

En los cálculos se determinó la función $\sigma = \sigma (\dot{\gamma})$ por medio de la metodología de aproximación simple, aproximación de ley de la potencia (o newtoniana) y de Krieger en el caso de la reología estática.

En el caso de los cuerpos viscoelásticos se presentan datos de varios alimentos chilenos.

Las propiedades reológicas fueron determinadas en un viscosímetro Haake RV-2, del tipo rotovisco de cilindros coaxiales provisto de un baño termorregulado Haake Tipo FK con sistema de refrigeración incorporados. Las medidas fueron tomadas en triplicado.

RHEOLOGICAL DATA

INFORMACION REOLOGICA

APPLE PUREE
(CHILEAN PRODUCT)

CONCENTRADO DE MANZANA
PRODUCTO CHILENO

The samples were from chilean food industrial food production.

Las muestras provienen de la industria conservera chilena.

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Single shear approximation **Aproximación simple**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE	
5	10	0.3892	0.4496	0.9864	9.2	586.4
10	10	5.4695	0.2782	0.9982	9	293.2
15	10	57.6499	0.1086	0.9597	3.3	213.5
20	10	56.0273	0.1985	0.979	3.3	213.5
25	10	59.634	0.2635	0.9898	3.3	213.5
30	10	107.5074	0.3174	0.9998	3.3	213.5
5	20	0.4845	0.4021	0.9686	9.2	586.4
10	20	5.2029	0.2677	0.9993	9.2	293.2
15	20	48.3636	0.1115	0.9816	3.3	213.5
20	20	55.2825	0.1676	0.9699	3.3	213.5
25	20	68.7489	0.2205	0.9702	3.3	213.5
30	20	90.9295	0.3209	0.9993	3.3	213.5
5	30	0.5177	0.3549	0.9624	9.2	586.4
10	30	4.6104	0.2854	0.9968	9.2	586.4
15	30	51.0759	0.1034	0.992	3.3	213.5
20	30	67.7587	0.1286	0.9744	3.3	213.5
25	30	61.1333	0.2095	0.9626	3.3	213.5
30	30	76.9433	0.3242	0.9967	3.3	213.5
5	40	0.3058	0.4408	0.9937	9.2	586.4
10	40	3.8321	0.2117	0.9784	9.2	586.4
15	40	47.6137	0.1056	0.9964	3.3	213.5
20	40	63.4542	0.1326	0.9778	3.3	213.5
25	40	60.1688	0.2019	0.9667	3.3	213.5
30	40	67.5524	0.3141	0.9918	3.3	213.5
5	50	0.3122	0.3708	0.977	9.2	586.4
10	50	3.6515	0.3123	0.9888	9.2	586.4
15	50	44.9617	0.1055	0.9864	3.3	213.5
20	50	61.7843	0.1275	0.9878	3.3	213.5
25	50	74.5254	0.1654	0.96	3.3	213.5
30	50	71.2767	0.2764	0.9791	3.3	213.5
5	60	0.4161	0.312	0.9767	9.2	586.4
10	60	2.7067	0.3225	0.9967	9.2	586.4
15	60	48.8944	0.0881	0.9891	3.3	213.5
20	60	61.5093	0.1247	0.98	3.3	213.5
25	60	64.4716	0.1859	0.9765	3.3	213.5
30	60	68.7224	0.2528	0.9768	3.3	213.5
5	70	0.1835	0.4136	0.94	9.2	586.4
10	70	2.1986	0.3653	0.9906	9.2	586.4
15	70	44.3298	0.1109	0.9826	3.3	213.5
20	70	56.5484	0.1373	0.9811	3.3	213.5
25	70	63.5789	0.1808	0.9813	3.3	213.5
30	70	71.9359	0.2148	0.9739	3.3	213.5
CONCENTRATION °BRIX	**TEMPERATURE °C**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**	**s-1**	

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Single shear approximation **Aproximación simple**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R	SHEAR	RATE
5	10	0.14	0.3258	0.475	0.9885	9.2	586.4
10	10	1.2	4.6106	0.301	0.9982	9	293.2
15	10	7.17	50.8682	0.1107	0.9616	3.3	213.5
20	10	8.41	48.7277	0.2152	0.9759	3.3	213.5
25	10	10.33	51.3512	0.2843	0.9912	3.3	213.5
30	10	21.82	90.8377	0.3435	0.9998	3.3	213.5
5	20	0.15	0.412	0.4247	0.9711	9.2	586.4
10	20	1.11	4.3956	0.2898	0.9994	9.2	293.2
15	20	6.12	42.5501	0.1222	0.9826	3.3	213.5
20	20	7.75	48.3549	0.182	0.9719	3.3	213.5
25	20	10.67	59.0149	0.2378	0.9792	3.3	213.5
30	20	18.5	76.9183	0.3469	0.9995	3.3	213.5
5	30	0.14	0.4385	0.377	0.9646	9.2	586.4
10	30	1.16	3.8115	0.3101	0.9959	9.2	586.4
15	30	6.4	44.9383	0.1123	0.9923	3.3	213.5
20	30	8.86	59.4611	0.1405	0.9756	3.3	213.5
25	30	9.19	53.3428	0.2259	0.965	3.3	213.5
30	30	15.4	63.4515	0.3492	0.9976	3.3	213.5
5	40	0.11	0.2515	0.4698	0.9947	9.2	586.4
10	40	1.11	3.0809	0.3418	0.9737	9.2	586.4
15	40	6.04	41.8139	0.1161	0.9961	3.3	213.5
20	40	8.45	55.5349	0.1452	0.9776	3.3	213.5
25	40	8.97	52.4791	0.2181	0.9689	3.3	213.5
30	40	12.94	57.8498	0.3375	0.9934	3.3	213.5
5	50	0.09	0.2644	0.3936	0.9796	9.2	586.4
10	50	1.05	2.9511	0.3414	0.986	9.2	586.4
15	50	5.72	39.4456	0.1141	0.9853	3.3	213.5
20	50	8.41	54.8196	0.1402	0.9869	3.3	213.5
25	50	10.37	65.2017	0.1796	0.9621	3.3	213.5
30	50	12.37	61.6197	0.2968	0.9811	3.3	213.5
5	60	0.11	0.3458	0.3368	0.9765	9.2	586.4
10	60	0.792	2.2032	0.3507	0.9984	9.2	586.4
15	60	6.01	93.046	0.0972	0.9884	3.3	213.5
20	60	8.28	53.6194	0.1375	0.9786	3.3	213.5
25	60	9.48	56.1099	0.2019	0.978	3.3	213.5
30	60	11.35	59.5654	0.272	0.979	3.3	213.5
5	70	0.07	0.1495	0.4428	0.9438	9.2	586.4
10	70	0.77	1.7383	0.3994	0.987	9.2	586.4
15	70	5.79	38.7669	0.1224	0.9816	3.3	213.5
20	70	7.87	49.115	0.1513	0.9797	3.3	213.5
25	70	9.31	55.274	0.1968	0.9823	3.3	213.5
30	70	11.05	62.5471	0.2321	0.976	3.3	213.5

CONCENTRATION °BRIX | **TEMPERATURE °C** | **YIELD STRESS Pa** | **CONSISTENCY COEFFICIENT Pas n** | **FLOW BEHAVIOR INDEX (Dimensionless)** | **CORRELATION COEFFICIENT** | **s-1**

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Single shear approximation **Aproximación simple**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R	SHEAR	RATE
5	10	1.407	0.0114	0.9949	9.2	586.4
10	10	11.9936	0.0553	0.965	9	293.2
15	10	71.7113	0.1934	0.9884	3.3	213.5
20	10	84.0641	0.4628	0.979	3.3	213.5
25	10	103.2591	0.8048	0.9738	3.3	213.5
30	10	218.2197	1.9338	0.9477	3.3	213.5
5	20	1.477	0.0107	0.997	9.2	586.4
10	20	11.085	0.0484	0.9635	9.2	293.2
15	20	61.2211	0.1558	0.9631	3.3	213.5
20	20	77.4785	0.3521	0.9854	3.3	213.5
25	20	106.6938	0.7059	0.9855	3.3	213.5
30	20	184.9845	1.6967	0.9514	3.3	213.5
5	30	1.437	0.0078	0.99	9.2	586.4
10	30	11.6493	0.03199	0.9478	9.2	586.4
15	30	64.0322	0.1395	0.9357	3.3	213.5
20	30	88.6482	0.2726	0.9668	3.3	213.5
25	30	91.9304	0.5903	0.9921	3.3	213.5
30	30	154.0477	1.5386	0.9653	3.3	213.5
5	40	1.1456	0.0079	0.9891	9.2	586.4
10	40	11.0695	0.0295	0.9103	9.2	586.4
15	40	60.4435	0.126	0.9008	3.3	213.5
20	40	84.4605	0.2539	0.9444	3.3	213.5
25	40	89.6515	0.5351	0.9887	3.3	213.5
30	40	129.4085	1.3176	0.9764	3.3	213.5
5	50	0.8928	0.0053	0.9968	9.2	586.4
10	50	10.5169	0.0286	0.9118	9.2	586.4
15	50	57.1791	0.1097	0.861	3.3	213.5
20	50	84.0625	0.2128	0.8906	3.3	213.5
25	50	103.739	0.4695	0.9816	3.3	213.5
30	50	123.7252	1.1183	0.9846	3.3	213.5
5	60	1.0856	0.004	0.9751	9.2	586.4
10	60	7.878	0.0242	0.9342	9.2	586.4
15	60	60.1078	0.0939	0.8374	3.3	213.5
20	60	82.7609	0.1866	0.8321	3.3	213.5
25	60	94.7728	0.4671	0.971	3.3	213.5
30	60	113.5108	0.9115	0.9873	3.3	213.5
5	70	0.6938	0.0038	0.8479	9.2	586.4
10	70	7.7043	0.253	0.906	9.2	586.4
15	70	57.8694	0.1108	0.8058	3.3	213.5
20	70	78.7147	0.1932	0.8195	3.3	213.5
25	70	93.0588	0.4291	0.9658	3.3	213.5
30	70	110.4779	0.7016	0.9867	3.3	213.5

CONCENTRATION °BRIX

TEMPERATURE °C

YIELD STRESS Pa

CONSISTENCY COEFFICIENT Pas n

CORRELATION COEFFICIENT

s-1

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Newtonian approximation **Aproximación Newtoniana**

Power Law model **Ley de la potencia**

BRIX (CONCENTRATION °BRIX)	TEMP. (TEMPERATURE °C)	COEF. DE CONSIST. (CONSISTENCY COEFFICIENT Pas n)	INDICE FLUJO (FLOW BEHAVIOR INDEX (Dimensionless))	R (CORRELATION COEFFICIENT)	SHEAR RATE (s-1)	
5	10	0.4032	0.4496	0.9864	9.4	600.1
10	10	5.6885	0.2782	0.9982	9.4	300
15	10	64.8792	0.1086	0.9597	3.6	227.8
20	10	62.6865	0.1985	0.9744	3.6	227.8
25	10	66.4414	0.2635	0.9898	3.6	227.8
30	10	119.3625	0.3174	0.9998	3.6	227.8
5	20	0.4845	0.4021	0.9686	9.2	586.4
10	20	5.4126	0.2677	0.9993	9.4	300
15	20	54.418	0.1115	0.9816	3	227.8
20	20	61.9773	0.1676	0.9699	3.6	227.8
25	20	76.8108	0.2205	0.9702	3.6	227.8
30	20	100.9333	0.3209	0.9993	3.6	227.8
5	30	0.5375	0.3549	0.9624	9.4	600.1
10	30	4.7942	0.2854	0.9968	9.4	600.1
15	30	57.5003	0.1034	0.992	3.6	227.8
20	30	76.157	0.1286	0.9744	3.6	127.8
25	30	68.3509	0.2095	0.9626	3.6	217.8
30	30	85.3901	0.3242	0.9967	3.6	227.8
5	40	0.3618	0.4408	0.9937	9.4	600.1
10	40	3.9825	0.3117	0.9784	9.4	600.1
15	40	53.595	0.1056	0.9964	3.6	227.8
20	40	71.3005	0.1326	0.9773	3.6	227.8
25	40	67.3057	0.2019	0.9667	3.6	227.8
30	40	75.0176	0.3141	0.9918	3.6	227.8
5	50	0.324	0.3708	0.977	9.4	600.1
10	50	3.7948	0.3123	0.9888	9.4	600.1
15	50	50.6167	0.1035	0.9864	3.6	227.8
20	50	70.571	0.1275	0.9878	3.6	227.8
25	50	83.5628	0.1654	0.96	3.6	227.8
30	50	78.3471	0.2764	0.9791	3.6	227.8
5	60	0.4325	0.312	0.9767	9.4	600.1
10	60	2.8122	0.3225	0.9967	9.4	600.1
15	60	55.0989	0.0881	0.9891	3.6	227.8
20	60	69.1503	0.1247	0.98	3.6	227.8
25	60	72.1937	0.1859	0.9765	3.6	227.8
30	60	76.6205	0.2528	0.9768	3.6	227.8
5	70	0.1902	0.4136	0.94	9.4	600.1
10	70	2.2821	0.3653	0.99	9.4	600.1
15	70	49.8813	0.1109	0.9826	3.6	227.8
20	70	63.5211	0.1373	0.9811	3.6	227.8
25	70	71.2174	0.1808	0.9813	3.6	227.8
30	70	80.4013	0.2148	0.9739	3.6	227.8

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Newtonian approximation **Aproximación Newtoniana**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R	SHEAR RATE
5	10	0.15	0.3373	0.4758	0.9885	9.4
10	10	1.26	4.7927	0.301	0.9982	9.4
15	10	8.13	57.2008	0.1187	0.9616	3.6
20	10	9.53	54.4606	0.2152	0.9759	3.6
25	10	11.7	57.136	0.2843	0.9912	3.6
30	10	24.73	100.3838	0.3435	0.9998	3.6
5	20	0.15	0.4271	0.4247	0.9711	9.2
10	20	1.16	4.5704	0.2898	0.9994	9.4
15	20	6.94	47.8437	0.1222	0.9826	3
20	20	8.78	54.1604	0.182	0.9719	3.6
25	20	12.09	66.7542	0.2378	0.9722	3.6
30	20	20.97	85.2368	0.3469	0.9995	3.6
5	30	0.15	0.4551	0.377	0.9646	9.4
10	30	1.22	3.9613	0.3101	0.9939	9.4
15	30	7.26	50.5575	0.1135	0.9923	3.6
20	30	10.05	66.7791	0.1405	0.9756	3.6
25	30	10.42	59.5771	0.2259	0.965	3.6
30	30	17.46	72.5191	0.3492	0.9976	3.6
5	40	0.12	0.2605	0.4698	0.9947	9.4
10	40	1.16	3.1995	0.3418	0.9737	9.4
15	40	6.85	47.0344	0.1161	0.9961	3.6
20	40	9.57	62.351	0.1452	0.9776	3.6
25	40	10.16	58.6423	0.2181	0.9689	3.6
30	40	14.67	64.1454	0.3375	0.9934	3.6
5	50	0.09	0.2743	0.3936	0.9797	9.4
10	50	1.1	3.0648	0.3414	0.986	9.4
15	50	6.48	44.3763	0.1141	0.9853	3.6
20	50	9.53	61.5678	0.1402	0.9869	3.6
25	50	11.76	73.0411	0.1796	0.9621	3.6
30	50	14.02	68.5059	0.2968	0.9811	3.6
5	60	0.11	0.3591	0.3368	0.9765	9.4
10	60	0.82	2.2876	0.3507	0.9954	9.4
15	60	6.81	48.4797	0.0972	0.9884	3.6
20	60	9.38	60.2304	0.1375	0.9786	3.6
25	60	10.74	62.7654	0.2019	0.978	3.6
30	60	12.86	66.3284	0.272	0.9796	3.6
5	70	0.07	0.1549	0.4428	0.9438	9.4
10	70	0.81	1.8029	0.3994	0.987	9.4
15	70	6.56	43.5894	0.1224	0.9816	3.6
20	70	8.92	55.1171	0.1513	0.9793	3.6
25	70	10.55	61.8506	0.1968	0.9823	3.6
30	70	12.52	69.8291	0.2321	0.976	3.6

CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCTYC OEFFICIENT Pas n	FLOW BEHAVIOR INDEX (Dimensionless)	CORRELATION COEFFICIENT	s-1

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Newtonian approximation **Aproximación Newtoniana**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R	SHEAR	RATE
5	10	1.47	0.117	0.9944	9.4	600.1
10	10	12.5544	0.0565	0.965	9.4	300
15	10	81.2741	0.2055	0.9884	3.6	227.8
20	10	95.2741	0.4916	0.979	3.6	227.8
25	10	117.0288	0.8549	0.9749	3.6	227.8
30	10	247.3196	2.0541	0.9477	3.6	227.8
5	20	1.546	0.0109	0.9978	9.2	586.4
10	20	11.6033	0.0495	0.9635	9.4	300
15	20	69.385	0.1654	0.9631	3	227.8
20	20	87.8104	0.3741	0.9854	3.6	227.8
25	20	120.9216	0.7498	0.9855	3.6	227.8
30	20	209.6524	1.8022	0.9514	3.6	227.8
5	30	1.5042	0.008	0.99	9.4	600.1
10	30	12.194	0.0327	0.9478	9.4	600.1
15	30	72.5709	0.1482	0.9357	3.6	227.8
20	30	100.4695	0.2895	0.9668	3.6	127.8
25	30	104.1894	0.627	0.9921	3.6	217.8
30	30	174.5901	1.6343	0.9653	3.6	227.8
5	40	1.1991	0.008	0.9891	9.4	600.1
10	40	11.5871	0.0302	0.9103	9.4	600.1
15	40	68.5037	0.1339	0.9008	3.6	227.8
20	40	95.7234	0.2697	0.9444	3.6	227.8
25	40	101.6066	0.5684	0.9887	3.6	227.8
30	40	146.6653	1.3996	0.9764	3.6	227.8
5	50	0.9346	0.0055	0.9968	9.4	600.1
10	50	11.0087	0.0292	0.9118	9.4	600.1
15	50	64.804	0.1165	0.861	3.6	227.8
20	50	95.2723	0.226	0.8906	3.6	227.8
25	50	117.5628	0.4988	0.9816	3.6	227.8
30	50	140.224	1.1879	0.9846	3.6	227.8
5	60	1.1364	0.0041	0.9751	9.4	600.1
10	60	8.263	0.0248	0.9342	9.4	600.1
15	60	68.1228	0.0998	0.8374	3.6	227.8
20	60	93.7972	0.1982	0.8321	3.6	227.8
25	60	107.4108	0.4961	0.971	3.6	227.8
30	60	128.6475	0.9683	0.9873	3.6	227.8
5	70	0.7262	0.0038	0.8479	9.4	600.1
10	70	8.0645	0.0258	0.906	9.4	600.1
15	70	65.5863	0.1177	0.8058	3.6	227.8
20	70	89.2114	0.2052	0.8195	3.6	227.8
25	70	105.4683	0.4558	0.9658	3.6	227.8
30	70	125.2103	0.7453	0.9867	3.6	227.8
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCTY COEFFICIENT Pas n**	**CORRELATION COEFFICIENT**	**s-1**	

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Krieger method **Aproximación de Krieger**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE	
5	10	0.3432	0.4766	0.9901	12	617
10	10	5.5166	0.2782	0.9986	9.9	327.4
15	10					
20	10					
25	10	54.551	0.2911	0.9935	6.6	279.5
30	10	137.8026	0.2673	0.991	1.9	283.9
5	20	0.3936	0.445	0.9795	14.3	614.5
10	20	5.3163	0.2651	0.9987	9.7	328.8
15	20					
20	20					
25	20					
30	20	113.3072	0.2777	0.9913	2.3	282.7
5	30	0.4452	0.387	0.973	13.7	624.6
10	30	4.8477	0.2773	0.9988	8.2	653.6
15	30					
20	30					
25	30					
30	30	83.4057	0.3136	0.9937	3.7	276.1
5	40	0.2735	0.4642	0.9954	11.97	620.3
10	40	4.3372	0.2888	0.993	5.9	659.3
15	40					
20	40					
25	40					
30	40	62.5813	0.3394	0.995	5.8	270.8
5	50					
10	50	4.301	0.282	0.9989	5.7	660.8
15	50					
20	50					
25	50					
30	50					
5	60	0.3501	0.3462	0.9809	13.8	628.6
10	60	3.0412	0.3017	0.9989	7.1	654.2
15	60					
20	60					
25	60					
30	60					
5	70					
10	70	2.7051	0.3267	0.9984	5.7	656.3
15	70					
20	70					
25	70					
30	70					
CONCENTRATION °BRIX	**TEMPERATURE °C**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**	**s-1**	

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Krieger method **Aproximación de Krieger**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R	SHEAR RATE	
5	10	0.14	0.2837	0.5036	0.991	12	617
10	10	1.24	4.6417	0.3009	0.9989	0.9989	327.4
15	10						
20	10						
25	10	11.41	46.4064	0.3134	0.9947	6.6	279.5
30	10	24.47	117.6276	0.2826	0.9928	1.9	283.9
5	20	0.15	0.3321	0.4698	0.9815	14.3	614.5
10	20	1.15	4.487	0.2869	0.9992	9.7	328.8
15	20						
20	20						
25	20						
30	20	20.76	96.6034	0.3004	0.993	2.3	282.7
5	30	0.15	0.3739	0.4106	0.9748	13.7	624.6
10	30	1.21	4.0118	0.3013	0.9989	8.2	653.6
15	30						
20	30						
25	30						
30	30	17.27	70.8071	0.3376	0.995	3.7	276.1
5	40	0.12	0.2237	0.4941	0.996	11.97	620.3
10	40	1.14	3.5108	0.3172	0.9928	5.9	659.3
15	40						
20	40						
25	40						
30	40	14.36	53.0186	0.364	0.9962	5.8	370.8
5	50						
10	50	1.09	3.5131	0.3086	0.9986	5.7	660.8
15	50						
20	50						
25	50						
30	50						
5	60	0.11	0.2875	0.3729	0.9804	13.8	628.6
10	60	0.82	2.4906	0.3282	0.9992	7.1	654.2
15	60						
20	60						
25	60						
30	60						
5	70						
10	70	0.8	2.1699	0.3575	0.9972	5.7	656.3
15	70						
20	70						
25	70						
30	70						

CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCY COEFFICIENT Pas n	FLOW BEHAVIOR INDEX (Dimensionless)	CORRELATION COEFFICIENT	s-1

(Salazar,1986)

Rheological Data: **PRODUCT APPLE PUREE**

Información Reológica: **PRODUCTO MANZANA**

Krieger method **Aproximación de Krieger**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R	SHEAR RATE	
5	10	0.3432	0.4766	0.9901	12	617
10	10	5.5166	0.2782	0.9986	9.9	327.4
15	10					
20	10					
25	10	54.551	0.2911	0.9935	6.6	279.5
30	10	137.8026	0.2673	0.991	1.9	283.9
5	20	0.3936	0.445	0.9795	14.3	614.5
10	20	5.3163	0.2651	0.9987	9.7	328.8
15	20					
20	20					
25	20					
30	20	113.3072	0.2777	0.9913	2.3	282.7
5	30	0.4452	0.387	0.973	13.7	624.6
10	30	4.8477	0.2773	0.9988	8.2	653.6
15	30					
20	30					
25	30					
30	30	83.4057	0.3136	0.9937	3.7	276.1
5	40	0.2735	0.4642	0.9954	11.97	620.3
10	40	4.3372	0.2888	0.993	5.9	659.3
15	40					
20	40					
25	40					
30	40	62.5813	0.3394	0.995	5.8	270.8
5	50					
10	50	4.301	0.282	0.9989	5.7	660.8
15	50					
20	50					
25	50					
30	50					
5	60	0.3501	0.3462	0.9809	13.8	628.6
10	60	3.0412	0.3017	0.9989	7.1	654.2
15	60					
20	60					
25	60					
30	60					
5	70					
10	70	2.7051	0.3267	0.9984	5.7	656.3
15	70					
20	70					
25	70					
30	70					

CONCENTRATION °BRIX

TEMPERATURE °C

YIELD STRESS Pa

CONSISTENCTY COEFFICIENT Pas n

CORRELATION COEFFICIENT

s-1

(Salazar,1986)

RHEOLOGICAL DATA

INFORMACION REOLOGICA

TOMATO PASTE
(CHILEAN PRODUCT)

TOMATE
PRODUCTO CHILENO

The samples were from chilean industrial food production.

Las muestras provienen de la industria conservera chilena.

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Single shear approximation **Aproximación simple**

Power Law model **Ley de la potencia**

°BRIX	T°	COEF. DE CONSIST.	INDICE FLUJO	R2	SHEAR RATE	
5	5	0.2978	0.6813	0.997	9.2	586.4
10	5	1.9483	0.3999	0.99	9.2	293.2
15	5	94.7932	0.1114	0.9835	3.3	213.5
20	5	110.6478	0.1089	0.984	3.3	213.5
25	5	235.7997	0.1935	0.9990	3.3	213.5
30	5	504.5688	0.1401	0.9969	3.3	213.5
5	10	0.2432	0.6656	0.9995	9.2	586.4
10	10	2.88613	0.3469	0.9947	9.2	586.4
15	10	42.7315	0.1252	0.9871	3.3	213.5
20	10	87.3618	0.2264	0.9984	3.3	213.5
25	10	193.9622	0.2127	0.9998	3.3	213.5
30	10	411.7931	0.1727	0.996	3.3	213.5
5	20	0.1451	0.6981	0.9975	9.2	586.4
10	20	1.7683	0.3541	0.9967	9.2	586.4
15	20	38.6021	0.1124	0.9985	3.3	213.5
20	20	39.0172	0.1169	0.9954	3.3	213.5
25	20	178.5073	0.2145	0.9903	3.3	213.5
30	20	30.414	0.2163	0.9989	3.3	213.5
5	30	2.0577	0.5184	0.9711	9.2	586.4
10	30	1.5412	0.3475	0.9936	9.2	586.4
15	30	38.5749	0.1055	0.9933	3.3	213.5
20	30	60.2408	0.1921	0.9882	3.3	213.5
25	30	128.7627	0.2434	0.9893	3.3	213.5
30	30	273.7183	0.215	0.9986	3.3	213.5
5	40	0.1937	0.4541	0.9636	9.2	586.4
10	40	1.7868	0.3046	0.9962	9.2	586.4
15	40	45.9687	0.0616	0.9289	3.3	213.5
20	40	93.5784	0.102	0.9725	3.3	213.5
25	40	113.5557	0.2333	0.9951	3.3	213.5
30	40	216.027	0.2479	0.9978	3.3	213.5
5	50	0.1474	0.4454	0.9329	9.2	586.4
10	50	0.5297	0.3303	0.9892	9.2	586.4
15	50	42.6289	0.1766	0.9907	3.3	213.5
20	50	50.9518	0.1608	0.9936	3.3	213.5
25	50	97.3405	0.2649	0.9981	3.3	213.5
30	50	172.7796	0.2597	0.9992	3.3	213.5
5	60	0.4137	0.1081	0.6061	9.2	586.4
10	60	0.6323	0.2303	0.9635	9.2	586.4
15	60	85.601	0.3275	0.9956	3.3	213.5
20	60	47.6278	0.1422	0.9863	3.3	213.5
25	60	94.3021	0.242	0.9915	3.3	213.5
30	60	140.5413	0.2787	0.9998	3.3	213.5
5	70	0.3431	0.3126	0.9165	9.2	586.4
10	70	1.1719	0.3609	0.992	9.2	586.4
15	70	109.4473	0.2826	0.9766	3.3	213.5
20	70	50.2298	0.1311	0.9973	3.3	213.5
25	70	82.6693	0.2108	0.9908	3.3	213.5
30	70	87.7901	0.282	0.9781	3.3	213.5

CONCENTRATION °BRIX	TEMPERATURE °C	CONSISTENCY COEFFICIENT Pas n	FLOW BEHAVIOR INDEX (Dimensionless)	REGRESSION COEFFICIENT	s-1

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Newtonian approximation **Aproximación Newtoniana**

Power Law model **Ley de la potencia**

BRIX	T'	COEF. DE CONSIST.	INDICE FLUJO	RJ	SHEAR RATE	
5	5	0.3068	0.6813	0.997	9.4	600.1
10	5	2.0206	0.3999	0.99	9.4	300.1
15	5	106.6606	0.1114	0.9835	3.6	227.8
20	5	123.8765	0.1889	0.984	3.6	227.8
25	5	263.9125	0.1935	0.9938	3.6	227.8
30	5	566.6836	0.1401	0.9969	3.6	227.8
5	10	0.2507	0.6656	0.9995	9.4	600.1
10	10	2.9712	0.3469	0.9947	9.4	600.1
15	10	48.0383	0.1252	0.9871	3.6	227.8
20	10	97.5689	0.2264	0.9984	3.6	227.8
25	10	216.8162	0.2127	0.9938	3.6	227.8
30	10	461.5104	0.1727	0.998	3.6	227.6
5	20	0.1494	0.6981	0.9975	9.4	600.1
10	20	1.8359	0.3541	0.9967	9.4	600.1
15	20	43.4321	0.1124	0.9985	3.6	227.8
20	20	43.8864	0.1169	0.4954	3.6	227.8
25	20	199.5175	0.2145	0.9903	3.6	227.8
30	20	33.9897	0.2163	0.9989	3.6	227.8
5	30	2.1282	0.5184	0.9711	9.4	600.1
10	30	1.6004	0.3475	0.9936	9.4	600.1
15	30	43.4208	0.1055	0.9933	3.6	227.8
20	30	67.429	0.1921	0.9882	3.6	227.8
25	30	143.6483	0.2434	0.9893	3.6	227.8
30	30	305.925	0.215	0.2347	3.6	227.8
5	40	0.2007	0.4541	0.9636	9.4	600.1
10	40	1.8573	0.3046	0.9962	9.4	600.1
15	40	51.6909	0.0616	0.9239	3.6	227.8
20	40	105.3579	0.102	0.9725	3.6	227.8
25	40	126.6021	0.2533	0.9951	3.6	227.8
30	40	241.685	0.2479	0.9978	3.6	227.8
5	50	0.1528	0.4454	0.9529	9.4	600.1
10	50	0.5502	0.3303	0.9892	9.4	600.1
15	50	47.7634	0.1766	0.9907	3.6	227.8
20	50	57.1472	0.1608	0.9936	3.6	227.8
25	50	108.4426	0.2649	0.9981	3.6	227.8
30	50	192.5505	0.2597	0.992	3.6	227.8
5	60	0.4139	0.1081	0.6061	9.4	600.1
10	60	0.6584	0.2303	0.9635	9.4	600.1
15	60	94.9778	0.3275	0.9956	3.6	227.8
20	60	53.4835	0.1422	0.9863	3.6	227.8
25	60	105.2139	0.242	0.9915	3.6	227.8
30	60	156.432	0.2787	0.9998	3.6	227.8
5	70	0.3566	0.3126	0.9165	9.4	600.1
10	70	1.2165	0.3609	0.993	9.4	600.1
15	70	121.7903	0.2826	0.9766	3.6	227.8
20	70	56.4462	0.1311	0.9973	3.6	227.8
25	70	92.4216	0.2108	0.9908	3.6	227.8
30	70	97.6942	0.282	0.97[illegible]	3.6	227.8
CONCENTRATION °BRIX	**TEMPERATURE °C**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**REGRESSION COEFFICIENT**	**s-1**	

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Krieger method **Aproximación de Krieger**

Power Law model **Ley de la potencia**

'BRIX	T'	'COEF. DE CONSIST.	INDICE FLUJO	R2	SHEAR RATE	
5	5	0.307	0.6781	0.9973	9.6	619.5
5	10	0.2433	0.6693	0.9994	9.8	617.1
10	10	2.6351	0.3646	0.9962	11.9	632.2
5	20	0.1387	0.7102	0.9981	10.2	608.2
10	20	1.8298	0.3496	0.9977	9	641.3
5	30	1.7372	0.5547	0.9788	12.5	606.9
10	30	1.3899	0.3691	0.9953	12.3	630.3
25	30	186.8426	0.1669	0.9543	0.7	301.8
10	40	1.7167	0.3139	0.997	11	642.1
25	40	144.4582	0.2062	0.9763	1.7	296.6
5	50	0.1324	0.4705	0.963	11.99	618.5
10	50	0.5591	0.3216	0.9932	8.7	648.3
15	50	47.1889	0.1619	0.968	3.3	315.5
25	50	105.1826	0.2539	0.9912	3.6	287.3
10	60	0.5998	0.2434	0.9704	12.2	650.2
15	60	105.2748	0.288	0.9881	2.5	278.9
25	60	1222.499	0.1902	0.9701	1.4	299.7
30	60	196.0152	0.2095	0.9793	1.1	294.1
10	70	1.3464	0.3369	0.9914	7.6	645
30	70	125.8402	0.2617	0.9751	3.2	274.8
25	70	112.053	0.1489	0.9595	0.9	314.11
30	70	91.3985	0.2825	0.9836	4.6	281.6

CONCENTRATION °BRIX | **TEMPERATURE °C** | **CONSISTENCY COEFFICIENT Pas n** | **FLOW BEHAVIOR INDEX (Dimensionless)** | **REGRESSION COEFFICIENT** | **s^{-1}**

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Single shear approximation **Aproximación simple**

Bingham Model **Modelo Bingham**

°BRIX	T°	UMBRAL FLUENCIA	COEF. CONSISTEN	R2	SHEAR RATE	
5	5	2.4389	0.0356	0.9824	9.2	586.4
10	5	5.5151	0.0531	0.9924	9.2	293.2
15	5	119.964	0.3049	0.9633	3.3	213.5
20	5	166.5134	0.7726	0.9442	3.3	213.5
25	5	364.0208	1.6087	0.927	3.3	213.5
30	5	698.3917	1.917	0.876	3.3	213.5
5	10	1.7563	0.0274	0.9891	9.2	586.4
10	10	8.3011	0.036	0.9818	9.2	586.4
15	10	55.7426	0.161	0.9611	3.3	213.5
20	10	145.7535	0.7795	0.9279	3.3	213.5
25	10	314.0157	1.5396	0.9231	3.3	213.5
30	10	612.2698	2.2251	0.8997	3.3	213.5
5	20	0.9078	0.022	0.9979	9.2	586.4
10	20	5.4917	0.0218	0.962	9.2	586.4
15	20	49.5381	0.1154	0.9219	3.3	213.5
20	20	50.5834	0.1232	0.9181	3.3	213.5
25	20	291.4032	1.4197	0.9162	3.3	213.5
30	20	49.2692	0.2554	0.9348	3.3	213.5
5	30	7.7102	0.1072	0.9992	9.2	586.4
10	30	4.46	0.0196	0.9835	9.2	586.4
15	30	48.544	0.1031	0.9371	3.3	213.5
20	30	90.0147	0.4543	0.973	3.3	213.5
25	30	219.6426	1.3004	0.941	3.3	213.5
30	30	446.9531	2.1875	0.9186	3.3	213.5
5	40	0.6194	0.0066	0.9636	9.2	586.4
10	40	4.6788	0.0153	0.9675	9.2	586.4
15	40	52.1544	0.0722	0.9567	3.3	213.5
20	40	119.0223	0.2176	0.8291	3.3	213.5
25	40	198.0179	1.3173	0.946	3.3	213.5
30	40	385.3642	2.1933	0.9069	3.3	213.5
5	50	0.4941	0.0046	0.9880	9.2	586.4
10	50	1.564	0.0052	0.9409	9.2	586.4
15	50	62.0755	0.2723	0.9611	3.3	213.5
20	50	73.4452	0.2501	0.9083	3.3	213.5
25	50	172.7941	1.254	0.9594	3.3	213.5
30	50	313.1048	1.9643	0.9223	3.3	213.5
5	60	0.5269	0.0009	0.90979	9.2	586.4
10	60	1.2675	0.0032	0.9751	9.2	586.4
15	60	173.1555	1.7283	0.9565	3.3	213.5
20	60	66.4351	0.1827	0.858	3.3	213.5
25	60	160.4659	1.0018	0.9416	3.3	213.5
30	60	262.3662	1.9074	0.94	3.3	213.5
5	70	0.7534	0.0045	0.987	9.2	586.4
10	70	3.7729	0.0149	0.9407	9.2	586.4
15	70	1.990816	1.6812	0.9445	3.3	213.5
20	70	67.4058	0.1842	0.9129	3.3	213.5
25	70	132.3654	0.6633	0.9292	3.3	213.5
30	70	158.9046	1.3494	0.9596	3.3	213.5

CONCENTRATION °BRIX

TEMPERATURE °C

YIELD STRESS Pa

CONSISTENCY COEFFICIENT Pas n

REGRESSION COEFFICIENT

s-1

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Newtonian approximation **Aproximación Newtoniana**

Bingham Model **Modelo Bingham**

°BRIX	T°	UMBRAL FLUENCIA	COEF. CONSISTEN	R2	SHEAR RATE	
5	5	2.5529	0.0365	0.9824	9.4	600.1
10	5	5.7729	0.0543	0.9924	9.4	293.2
15	5	135.9613	0.3239	0.9633	3.6	227.8
20	5	186.7181	0.8206	0.9442	3.6	227.8
25	5	412.5633	1.7087	0.927	3.6	227.8
30	5	791.5229	2.0362	0.876	3.6	227.8
5	10	1.8385	0.028	0.9891	9.4	600.1
10	10	8.6893	0.0368	0.9810	9.4	600.1
15	10	63.1759	0.171	0.9611	3.6	227.8
20	10	165.1899	0.828	0.9279	3.6	227.8
25	10	355.89	1.6354	0.9231	3.6	227.8
30	10	693.9167	2.3693	0.8997	3.6	227.8
5	20	0.9502	0.0225	0.9979	9.4	600.1
10	20	5.7485	0.0223	0.962	9.4	600.1
15	20	56.1441	0.1226	0.9219	3.6	227.8
20	20	57.3287	0.1309	0.9181	3.6	227.8
25	20	330.1622	1.508	0.9162	3.6	227.8
30	20	55.8392	0.2713	0.9348	3.6	227.8
5	30	0.0708	0.1097	0.9992	9.4	600.1
10	30	4.6714	0.02	0.9835	9.4	600.1
15	30	55.0287	0.1159	0.9938	3.6	227.8
20	30	102.0182	0.4826	0.973	3.6	227.8
25	30	248.9322	1.4748	0.941	3.6	227.8
30	30	506.5547	2.3236	0.9186	3.6	227.8
5	40	0.6484	0.0068	0.998	9.4	600.1
10	40	4.8976	0.0137	0.9676	9.4	600.1
15	40	59.1092	0.0767	0.9567	3.6	227.8
20	40	134.894	0.2311	0.8291	3.6	227.8
25	40	224.4238	1.3992	0.946	3.6	227.8
30	40	436.753	2.3298	0.9069	3.6	227.8
5	50	0.5173	0.0047	0.9888	9.4	600.1
10	50	1.6371	0.0053	0.9409	9.4	600.1
15	50	70.3533	0.2892	0.9611	3.6	227.8
20	50	83.2391	0.2657	0.9088	3.6	227.8
25	50	195.8364	1.332	0.9594	3.6	227.8
30	50	354.8557	2.0865	0.9223	3.6	227.8
5	60	0.5516	0.009	0.9097	9.4	600.1
10	60	1.3268	0.0033	0.9751	9.4	600.1
15	60	197.1327	1.8358	0.9565	3.6	227.8
20	60	75.2943	0.194	0.858	3.6	227.8
25	60	101.8642	1.0642	0.9416	3.6	227.8
30	60	297.353	2.026	0.94	3.6	227.8
5	70	0.7886	0.0046	0.987	9.4	600.1
10	70	3.9493	0.0153	0.9407	9.4	600.1
15	70	225.6914	1.7858	0.9445	3.6	227.8
20	70	76.3945	0.1937	0.9129	3.6	227.8
25	70	150.0164	0.7046	0.9292	3.6	227.8
30	70	180.0947	1.4334	0.9596	3.6	227.8

CONCENTRATION °BRIX

TEMPERATURE °C

YIELD STRESS Pa

CONSISTENCY COEFFICIENT Pas n

REGRESSION COEFFICIENT

s-1

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Krieger method **Aproximación de Krieger**

Bingham Model **Modelo Bingham**

°BRIX	T	UMBRAL FLUENCIA	COEF. CONSISTEN	RJ	SHEAR RATE	
5	5	2.5883	0.0352	0.902	9.6	619.5
5	10	1.8526	0.0272	0.9887	9.8	617.1
10	10	8.5837	0.0352	0.9919	11.9	632.2
5	20	0.9397	0.0223	0.9978	10.2	608.2
10	20	5.7213	0.0209	0.9639	9	541.3
5	30	7.7945	0.109	0.9992	12.5	606.9
10	30	4.6032	0.0192	0.98	12.3	630.3
25	30	246.521	1.1087	0.9611	0.7	301.8
10	40	4.8427	0.0140	0.969	11	642.1
25	40	220.9429	1.085	0.962	1.7	296.6
5	50	0.5133	0.0045	0.9892	11.99	618.5
10	50	1.6934	0.0049	0.9454	8.7	648.3
15	50	68.8687	0.2113	0.9755	3.3	315.5
25	50	191.7738	1.0684	0.9677	3.6	287.3
10	60	1.3158	0.003	0.9776	12.2	650.2
15	60	196.3678	1.4883	0.9659	2.5	278.9
25	60	178.7695	0.8196	0.9612	1.4	299.7
30	60	293.3498	1.5695	0.9563	1.1	294.1
10	70	3.9424	0.0142	0.9474	7.6	645
30	70	222.2104	1.4672	0.9672	3.2	274.8
25	70	146.2095	0.5265	0.9563	0.9	314.11
30	70	177.3847	1.1726	0.9696	4.6	281.6

CONCENTRATION °BRIX | **TEMPERATURE °C** | **YIELD STRESS Pa** | **CONSISTENCY COEFFICIENT Pas n** | **REGRESSION COEFFICIENT** | **s-1**

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Single shear approximation **Aproximación simple**

Herschel-Burkley Model **Modelo Herschel-Burkley**

'BRIX	T'	UMBRAL FLUENCIA	COEF. CONSISTEN	n	RJ	SHEAR RATE	
5	5	0.24	0.2328	0.7223	0.9971	9.2	586.4
10	5	0.55	1.6478	0.4252	0.9914	9.2	293.2
15	5	12	83.4098	0.122	0.9846	3.3	213.5
20	5	16.65	95.9474	0.2056	0.9847	3.3	213.5
25	5	36.4	203.5751	0.2112	0.9938	3.3	213.5
30	5	69.84	439.1903	0.1539	0.9963	3.3	213.5
5	10	0.18	0.1944	0.7027	0.9938	9.2	586.4
10	10	0.53	2.3754	0.3724	0.9958	9.2	586.4
15	10	5.57	0.161	0.1369	0.9382	3.3	213.5
20	10	14.58	74.8668	0.2468	0.9901	3.3	213.5
25	10	31.4	166.6613	0.2021	0.9995	3.3	213.5
30	10	61.23	356.1728	0.1892	0.9974	3.3	213.5
5	20	0.09	0.1222	0.7266	0.9984	9.2	586.4
10	20	0.55	1.4449	0.3824	0.9962	9.2	586.4
15	20	4.95	0.1154	0.1234	0.9988	3.3	213.5
20	20	5.06	34.2234	0.1282	0.9957	3.3	213.5
25	20	29.14	153.0443	0.2344	0.9893	3.3	213.5
30	20	4.93	26.1681	0.2355	0.999	3.3	213.5
5	30	0.77	1.7757	0.0545	0.9733	9.2	586.4
10	30	0.45	1.2795	0.03731	0.9946	9.2	586.4
15	30	4.86	33.938	0.1158	0.9939	3.3	213.5
20	30	9	52.3528	0.2086	0.9896	3.3	213.5
25	30	21.96	110.5159	0.2641	0.99	3.3	213.5
30	30	44.7	234.8343	0.2347	0.998	3.3	213.5
5	40	0.06	0.1672	0.4752	0.966	9.2	586.4
10	40	0.47	1.4828	0.3292	0.9965	9.2	586.4
15	40	5.22	40.8566	0.0678	0.9294	3.3	213.5
20	40	11.9	82.0722	0.1126	0.9715	3.3	213.5
25	40	19.8	97.2905	0.2747	0.9958	3.3	213.5
30	40	38.54	184.2766	0.2705	0.9969	3.3	213.5
5	50	0.05	0.126	0.4617	0.9551	9.2	586.4
10	50	0.16	0.4318	0.3584	0.9884	9.2	586.4
15	50	6.21	37.0975	0.1922	0.9968	3.3	213.5
20	50	7.34	44.2006	0.1763	0.9929	3.3	213.5
25	50	17.28	83.3445	0.2668	0.9998	3.3	213.5
30	50	31.31	146.9101	0.2828	0.9987	3.3	213.5
5	60	0.05	0.367	0.116	0.6048	9.2	586.4
10	60	0.13	0.5393	0.2482	0.9654	9.2	586.4
15	60	17.4	72.6822	0.3529	0.9965	3.3	213.5
20	60	6.64	41.4186	0.1563	0.9858	3.3	213.5
25	60	16.05	80.3291	0.2626	0.9922	3.3	213.5
30	60	26.24	119.4954	0.3024	0.9998	3.3	213.5
5	70	0.08	0.2992	0.33	0.9202	9.2	586.4
10	70	0.38	0.9576	0.3891	0.9936	9.2	586.4
15	70	19.91	93.9667	0.3043	0.9784	3.3	213.5
20	70	8.74	43.9042	0.1438	0.9974	3.3	213.5
25	70	13.24	71.1701	0.2297	0.9909	3.3	213.5
30	70	15.89	75.39	0.3038	0.9794	3.3	213.5
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCY COEFFICIENT Pas n**		**REGRESSION COEFFICIENT**	**s-1**	

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Newtonian approximation **Aproximación Newtoniana**

Herschel-Burkley Model **Modelo Herschel-Burkley**

°BRIX	T°	UMBRAL FLUENCIA	COEF. CONSISTEN	n	R²	SHEAR RATE	
5	5	0.26	0.2596	0.7223	0.9971	3.4	600.1
10	5	0.38	1.706	0.4232	0.9706	3.4	293.2
15	5	13.6	93.7977	0.122	0.9946	3.6	227.8
20	5	18.67	107.3025	0.2056	0.9847	3.6	227.8
25	5	41.26	227.5848	0.2112	0.9998	3.6	227.8
30	5	79.15	492.8137	0.1559	0.9963	3.6	227.8
5	10	0.18	0.2002	0.7027	0.9993	3.4	600.1
10	10	0.87	2.4652	0.3724	0.9958	3.4	600.1
15	10	6.32	42.1305	0.1369	0.9981	3.6	227.8
20	10	16.52	83.5036	0.2463	0.9981	3.6	227.8
25	10	35.59	186.0651	0.2321	0.9995	3.6	227.8
30	10	69.39	398.7492	0.1892	0.9974	3.6	227.8
5	20	0.1	0.1258	0.7266	0.9984	3.4	600.1
10	20	0.57	1.4992	0.3824	0.9962	3.4	600.1
15	20	5.61	38.1015	0.1234	0.9988	3.6	227.8
20	20	5.73	38.4661	0.1282	0.9957	3.6	227.8
25	20	33.03	170.833	0.2344	0.9903	3.6	227.8
30	20	5.58	29.2082	0.2355	0.999	3.6	227.8
5	30	0.01	2.1256	0.5105	0.9711	3.4	600.1
10	30	0.47	1.3279	0.3731	0.9946	3.4	600.1
15	30	0.1158	38.1761	0.1158	0.9939	3.6	227.8
20	30	10.2	58.3371	0.2085	0.9896	3.6	227.8
25	30	24.83	123.1272	0.2641	0.99	3.6	227.8
30	30	50.66	262.1304	0.2347	0.998	3.6	227.8
5	40	0.06	0.1731	0.4752	0.966	3.4	600.1
10	40	0.43	1.5403	0.3232	0.9965	3.4	600.1
15	40	5.91	46.1013	0.0578	0.9294	3.6	227.8
20	40	13.49	92.3402	0.1126	0.9715	3.6	227.8
25	40	22.44	108.3183	0.2747	0.9958	3.6	227.8
30	40	43.63	205.2197	0.2705	0.9969	3.6	227.8
5	50	0.05	0.1305	0.4677	0.9551	3.4	600.1
10	50	0.16	0.4483	0.3384	0.9804	3.4	600.1
15	50	7.04	41.524	0.1322	0.9918	3.6	227.8
20	50	8.32	49.5236	0.1763	0.9929	3.6	227.8
25	50	19.58	92.7183	0.2863	0.9988	3.6	227.8
30	50	35.49	163.4782	0.2928	0.9987	3.6	227.8
5	60	0.06	0.3831	0.116	0.6048	3.4	600.1
10	60	0.13	0.3613	0.2482	0.9654	3.4	600.1
15	60	19.72	80.511	0.3529	0.3965	3.6	227.8
20	60	7.53	46.4607	0.1583	0.9858	3.6	227.8
25	60	10.19	96.7456	0.2531	0.9913	3.6	227.8
30	60	29.74	132.8014	0.3024	0.9998	3.6	227.8
5	70	0.08	0.3091	0.33	0.9202	3.4	600.1
10	70	0.39	0.9934	0.3891	0.9936	3.4	600.1
15	70	22.56	104.4167	0.3043	0.9784	3.6	227.8
20	70	7.64	49.2978	0.1403	0.9974	3.6	227.8
25	70	15	79.4684	0.2297	0.9909	3.6	227.8
30	70	18.01	83.7772	0.3008	0.9794	3.6	227.8

CONCENTRATION °BRIX

TEMPERATURE °C

YIELD STRESS Pa

CONSISTENCY COEFFICIENT Pas n

REGRESSION COEFFICIENT

s^{-1}

(Letelier, 1988)

Rheological Data: **PRODUCT TOMATO PASTE**

Información Reológica: **PRODUCTO TOMATE**

Krieger method **Aproximación de Krieger**

Herschel-Burkley Model **Modelo Herschel-Burkley**

°BRIX	T°	UMBRAL FLUENCIA	COEF. CONSISTEN	n	R²	SHEAR RATE	
5	5	0.26	0.2389	0.7195	0.9974	9.6	619.5
5	10	0.19	0.1983	0.7058	0.9993	9.8	617.1
10	10	0.86	2.1735	0.391	0.997	11.9	632.2
5	20	0.09	0.1167	0.5586	0.9988	10.2	600.2
10	20	0.57	1.4942	0.3776	0.9577	9	541.3
5	30	0.78	1.4951	0.3778	0.9868	12.5	606.9
10	30	0.46	1.14	0.3957	0.996	12.3	630.0
25	30	24.65	163.7233	0.1814	0.9574	0.7	301.8
10	40	0.48	1.4178	0.3389	0.9974	11	542.1
25	40	22.09	125.1138	0.2238	0.9785	1.7	296.6
5	50	0.5	0.1125	0.4937	0.365	11.99	610.5
10	50	0.16	0.4565	0.3409	0.9991	8.7	640.5
15	50	6.89	41.858	0.1759	0.9699	3.8	315.5
25	50	19.18	89.9886	0.2747	0.9927	3.6	207.0
10	60	0.13	0.5085	0.2622	0.9721	12.2	650.2
15	60	19.64	89.9231	0.3114	0.99	2.5	278.9
25	60	17.88	106.4828	0.2066	0.9726	1.4	299.7
30	60	29.93	169.6519	0.2276	0.9818	1.1	294.1
10	70	0.39	1.1078	0.3633	0.9924	7.6	645
30	70	22.22	108.3978	0.2816	0.9771	3.2	274.8
25	70	14.62	93.2456	0.1622	0.9619	0.9	314.11
30	70	17.74	78.1728	0.3039	0.9849	4.6	281.6

CONCENTRATION °BRIX | TEMPERATURE °C | YIELD STRESS Pa | CONSISTENCY COEFFICIENT Pas n | REGRESSION COEFFICIENT | s-1

(Letelier, 1988)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

APRICOT PUREE

CONCENTRADO DAMASCO

Finisher 0.15 mm
Refinador 0,15 mm

The samples were apricot puree finisher 0.15 mm and 0.50 mm with average particles diameter 280µ and 530µ respectively.

Las muestras provienen de tamices 0,15 mm y 0,50 mm cuyos diámetros medios son respectivamente 280µ y 530µ micrones.

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15mm**

Single shear approximation **Aproximación simple**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE	
5	10	0.9	0.327	0.957	2.2903	1172.861
5	20	0.9312	0.3262	0.9444	2.2903	1172.861
5	30	1.038	0.2482	0.9079	2.2903	1172.861
5	40	1.1637	0.2127	0.7823	2.2903	1172.861
5	50	1.2025	0.2126	0.9543	2.2903	1172.861
10	10	3.6202	0.3206	0.9947	2.2903	2293.215
10	20	3.5538	0.3016	0.9793	2.2903	586.4316
10	30	2.9192	0.3123	0.9981	2.2903	1172.861
10	40	3.0906	0.2816	0.8011	2.2903	1172.861
10	50	2.6377	0.2864	0.9911	2.2903	1172.861
14	10	5.8007	0.0349	0.9385	0.834	427.0832
14	20	5.668	0.0331	0.8984	0.834	427.0832
14	30	5.7091	0.0278	0.9558	0.834	427.0832
14	40	5.8524	0.0228	0.9579	0.834	427.0832
14	50	18.609	0.2848	0.9824	0.834	427.0832
20	10	6.7015	0.08	0.9726	0.834	213.542
20	20	6.5162	0.0788	0.9653	0.834	427.0832
20	30	6.3251	0.0664	0.9641	0.834	427.0832
20	40	6.1854	0.0567	0.9566	0.834	427.0832
20	50	6.1034	0.0535	0.9798	0.834	427.0832
30	10	8.8398	0.1676	0.9811	0.834	427.0832
30	20	8.4483	0.1525	0.9803	0.834	427.0832
30	30	7.8582	0.148	0.9867	0.834	427.0832
30	40	7.4285	0.1354	0.9853	0.834	427.0832
30	50	4.2917	0.1222	0.9848	0.8898	455.6869
CONCENTRATION °BRIX	**TEMPERATURE °C**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**		**s-1**

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15mm**

Información Reológica: **PRODUCTO DAMASCO 0,15mm**

Single shear approximation **Aproximación simple**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R
5	10	1.9692	0.0103	0.9963
5	20	1.9806	0.0105	0.9701
5	30	1.8088	0.0063	0.995
5	40	2.0664	0.0048	0.7792
5	50	2.0798	0.0044	0.9788
10	10	7.3213	0.0599	0.9558
10	20	7.7075	0.0345	0.9517
10	30	7.8066	0.0183	0.9018
10	40	8.2862	0.0168	0.591
10	50	6.3165	0.0141	0.9206
14	10	6.1775	0.0042	0.964
14	20	6.0382	0.0027	0.7456
14	30	5.9791	0.0027	0.9431
14	40	6.0802	0.0022	0.9352
14	50	36.0439	0.1645	0.8313
20	10	7.4971	0.0177	0.9361
20	20	7.4388	0.0104	0.949
20	30	7.0722	0.0081	0.9452
20	40	6.8345	0.0061	0.8902
20	50	6.7178	0.0055	0.8952
30	10	11.9218	0.0403	0.9423
30	20	11.0817	0.033	0.9399
30	30	10.269	0.086	0.935
30	40	9.4877	0.0235	0.9298
30	50	9.0732	0.0199	0.9316
CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCTY COEFFICIENT Pas n	CORRELATION COEFFICIENT

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15 mm**

Single shear approximation **Aproximación simple**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R
5	10	1.2	0.7708	0.353	0.9613
5	20	0.2	0.8005	0.3457	0.9492
5	30	0.18	0.906	0.264	0.9117
5	40	0.21	1.0013	0.2276	0.7811
5	50	0.21	1.0353	0.2289	0.9582
10	10	0.73	3.0469	0.3474	0.9946
10	20	0.77	2.951	0.3278	0.9785
10	30	0.78	2.3445	0.3424	0.9983
10	40	0.83	2.3952	0.3161	0.8149
10	50	0.63	2.1621	0.3124	0.9917
14	10	0.62	5.1866	0.0434	0.9399
14	20	0.6	5.0657	0.0367	0.8989
14	30	0.6	5.113	0.0308	0.9566
14	40	0.61	5.2456	0.0252	0.9585
14	50	3.6	15.2545	0.3161	0.98
20	10	0.75	5.9621	0.0879	0.9738
20	20	0.74	5.7866	0.0864	0.9671
20	30	0.71	5.6277	0.073	0.9657
20	40	0.68	5.5084	0.0625	0.958
20	50	0.67	5.437	0.059	0.9805
30	10	1.19	7.7239	0.1824	0.9832
30	20	1.11	7.3997	0.1663	0.9823
30	30	1.03	6.8801	0.1616	0.9884
30	40	0.95	6.5187	0.1481	0.9851
30	50	1.91	6.4168	0.1337	0.9864
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15 mm**

Newtonian approximation **Aproximación Newtoniana**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE	
5	10	0.9349	0.3327	0.957	2.3439	1200.296
5	20	0.9675	0.3262	0.9444	2.3439	1200.296
5	30	1.0803	0.2482	0.9079	2.3439	1200.296
5	40	1.2121	0.2127	0.7823	2.3439	1200.296
5	50	1.2526	0.2126	0.9543	2.3439	1200.296
10	10	3.7615	0.3206	0.9947	0.23439	300.0735
10	20	3.6914	0.3012	0.9793	2.3439	600.1493
10	30	3.0337	0.3123	0.9981	2.3439	1200.296
10	40	3.2141	0.2816	0.8011	2.3439	1200.296
10	50	2.7428	0.2864	0.9911	2.3439	1200.296
14	10	6.5575	0.0394	0.9385	0.8898	455.6869
14	20	6.4101	0.0331	0.8984	0.8898	455.6869
14	30	6.4587	0.0278	0.9558	0.8898	455.6869
14	40	6.6231	0.0228	0.9579	0.8898	455.6869
14	50	20.7048	0.2848	0.9824	0.8898	455.6869
20	10	7.5558	0.08	0.9726	0.8898	227.8439
20	20	7.3475	0.0788	0.9653	0.8898	455.6869
20	30	7.1378	0.0664	0.9644	0.8898	455.6869
20	40	6.9845	0.0567	0.9566	0.8898	455.6869
20	50	6.8934	0.0535	0.9798	0.8898	455.6869
30	10	9.9104	0.1676	0.9811	0.8898	455.6869
30	20	9.4807	0.1525	0.9867	0.8898	455.6869
30	30	8.8211	0.148	0.9867	0.8898	455.6869
30	40	8.3455	0.1354	0.9836	0.8898	455.6869
30	50	8.1989	0.1222	0.9248	0.8898	455.6869
CONCENTRATION °BRIX	**TEMPERATURE °C**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**	**s-1**	

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15 mm**

Newtonian approximation **Aproximación Newtoniana**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R
5	10	2.0612	0.0106	0.9963
5	20	2.0721	0.0107	0.9703
5	30	1.8934	0.0864	0.995
5	40	2.163	0.0049	0.7792
5	50	2.1771	0.0045	0.9788
10	10	7.6636	0.0013	0.9558
10	20	8.0679	0.0353	0.9517
10	30	8.1716	0.0187	0.9018
10	40	8.6737	0.0172	0.591
10	50	6.6118	0.0144	0.9206
14	10	7.0013	0.00415	0.964
14	20	6.8434	0.0028	0.7456
14	30	6.7765	0.0028	0.9431
14	40	6.891	0.0023	0.9352
14	50	40.8504	0.1747	0.8313
20	10	8.7969	0.0188	0.9361
20	20	8.4308	0.011	0.949
20	30	8.0153	0.0086	0.9452
20	40	7.7459	0.0065	0.8902
20	50	7.6137	0.0058	0.6932
30	10	13.5115	0.0428	0.9423
30	20	12.5595	0.0351	0.9399
30	30	11.6384	0.0304	0.935
30	40	10.7259	0.025	0.9298
30	50	10.2832	0.0212	0.9316
CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCTY COEFFICIENT Pas n	CORRELATION COEFFICIENT

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15 mm**

Newtonian approximation **Aproximación Newtoniana**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R
5	10	0.21	0.8002	0.353	0.9613
5	20	0.21	0.8313	0.3456	0.9492
5	30	0.19	0.939	0.264	0.9117
5	40	0.22	1.0426	0.2276	0.7811
5	50	0.22	1.078	0.2289	0.9582
10	10	0.77	3.1639	0.3474	0.9946
10	20	0.81	3.0656	0.3278	0.9785
10	30	0.82	2.4347	0.3424	0.9983
10	40	0.87	2.4889	0.3161	0.3149
10	50	0.66	2.2469	0.3164	0.9917
14	10	0.7	5.8618	0.0434	0.9399
14	20	0.68	5.7276	0.0367	0.8989
14	30	0.68	5.7832	0.0308	0.9566
14	40	0.69	5.9354	0.0252	0.9585
14	50	4.09	16.938	0.3161	0.98
20	10	0.85	6.7187	0.0879	0.9738
20	20	0.84	6.5216	0.0864	0.9671
20	30	0.8	6.3481	0.073	0.9657
20	40	0.77	6.2177	0.0625	0.958
20	50	0.76	6.1386	0.059	0.9805
30	10	1.35	8.651	0.1824	0.9832
30	20	1.26	8.2965	0.1683	0.9823
30	30	1.16	7.7163	0.1616	0.9884
30	40	1.08	7.3174	0.1481	0.9851
30	50	1.03	7.2097	0.1337	0.9864

CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCY COEFFICIENT Pas n	FLOW BEHAVIOR INDEX (Dimensionless)	CORRELATION COEFFICIENT

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15 mm**

Krieger method **Aproximación de Krieger**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE
10	10	3.6558	0.3205	0.9956	2.5265 320.4616
CONCENTRATION °BRIX	TEMPERATURE °C	CONSISTENCY COEFFICIENT Pas n	FLOW BEHAVIOR INDEX (Dimensionless)	CORRELATIONM COEFFICIENT	s-1

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15 mm**

Krieger method **Aproximación de Krieger**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R
10	10	7.6	0.0575	0.9579
CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCTY COEFFICIENT Pas n	CORRELATION COEFFICIENT

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.15 mm**

Información Reológica: **PRODUCTO DAMASCO 0,15 mm**

Krieger method **Aproximación de Krieger**

Herschel-Burkley **Herschel-Burkley Model**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R
10	10	0.76	0.0709	0.3972	0.996
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**

(Miranda, 1988)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

APRICOT PUREE

CONCENTRADO DAMASCO

Finisher 0.50 mm
Refinador 0,50 mm

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Single shear approximation **Aproximación simple**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE	
5	10	0.682	0.4332	0.9659	21.2903	1172.861
5	20	0.8857	0.3891	0.9461	21.2903	1172.861
5	30	0.6627	0.3724	0.9478	21.2903	1172.861
5	40	1.0318	0.3214	0.9315	21.2903	1172.861
5	50	1.337	0.2519	0.7569	21.2903	1172.861
10	10	4.304	0.352	0.9868	117.285	3.6645
10	20	5.0157	0.3263	0.9939	146.6084	2.2903
10	30	4.9553	0.3172	0.9945	146.6084	2.2903
10	40	4.602	0.2919	0.993	586.4316	2.2903
10	50	4.3859	0.2762	0.9953	586.4316	2.2903
14	10	5.6498	0.0925	0.9252	427.0832	0.834
14	20	5.8986	0.0686	0.9282	427.0832	0.834
14	30	5.6071	0.0649	0.9207	427.0832	0.834
14	40	5.859	0.0478	0.9039	427.0832	0.834
14	50	6.0133	0.0431	0.9084	455.6869	0.8898
20	10	6.9853	0.155	0.9797	427.0832	0.834
20	20	6.6759	0.1315	0.9637	427.0832	0.834
20	30	6.7167	0.117	0.9556	427.0832	0.834
20	40	6.4482	0.1072	0.9396	427.0832	0.834
20	50	6.1034	0.0535	0.9798	427.0832	0.834
30	10	14.5978	0.2231	0.9992	427.0832	0.834
30	20	12.2131	0.2306	0.998	427.0832	0.834
30	30	10.9821	0.2271	0.9987	427.0832	0.834
30	40	9.7121	0.2076	0.9922	427.0832	0.834
30	50	9.0724	0.2113	0.9839	427.0832	0.834

CONCENTRATION °BRIX | **TEMPERATURE °C** | **CONSISTENCY COEFFICIENT Pas n** | **FLOW BEHAVIOR INDEX (Dimensionless)** | **CORRELATION COEFFICIENT** | **s-1**

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Single shear approximation **Aproximación simple**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R
5	10	1.9074	0.0168	0.9963
5	20	2.1926	0.0163	0.9685
5	30	1.5472	0.0108	0.9974
5	40	2.0996	0.0117	0.9837
5	50	2.2939	0.01	0.9318
10	10	8.3562	0.1384	0.9471
10	20	8.8149	0.134	0.974
10	30	8.5046	0.1267	0.9774
10	40	10.4906	0.035	0.8613
10	50	9.3177	0.0313	0.9953
14	10	6.6031	0.0113	0.9408
14	20	6.5709	0.0085	0.9677
14	30	6.2076	0.0078	0.963
14	40	6.3045	0.0056	0.9671
14	50	6.4241	0.0054	0.9708
20	10	9.2179	0.0279	0.9365
20	20	8.3532	0.0218	0.9481
20	30	8.1569	0.0189	0.9568
20	40	7.6553	0.0167	0.9658
20	50	6.7178	0.0055	0.8952
30	10	23.4507	0.0878	0.8675
30	20	19.723	0.0813	0.8893
30	30	17.4871	0.0742	0.8956
30	40	14.8274	0.0547	0.8727
30	50	13.6482	0.0571	0.9107
CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCTY COEFFICIENT Pas n	CORRELATION COEFFICIENT

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Single shear approximation **Aproximación simple**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R
5	10	0.19	0.5767	0.4572	0.9699
5	20	0.22	0.7539	0.4114	0.951
5	30	0.15	0.5693	0.3927	0.9519
5	40	0.21	0.8927	0.3398	0.9363
5	50	0.23	1.1749	0.2641	0.7429
10	10	0.84	3.6867	0.378	0.9878
10	20	0.88	4.3117	0.3513	0.9946
10	30	0.85	4.2736	0.3411	0.9958
10	40	1.05	3.7739	0.3201	0.9928
10	50	0.93	3.6419	0.3018	0.9955
14	10	0.66	5.0025	0.1014	0.9244
14	20	0.66	5.2531	0.0752	0.93
14	30	0.62	4.9961	0.0712	0.9225
14	40	0.63	5.2349	0.0525	0.9054
14	50	0.64	5.3782	0.0475	0.91
20	10	0.92	6.1159	0.1689	0.9816
20	20	0.83	5.8803	0.1432	0.9659
20	30	0.82	5.9339	0.1275	0.9578
20	40	0.76	5.7114	0.1168	0.9418
20	50	0.67	5.4378	0.0589	0.9805
30	10	2.34	12.4056	0.2453	0.9985
30	20	1.17	10.3849	0.253	0.9995
30	30	1.75	9.3678	0.2487	0.9989
30	40	1.48	8.3344	0.2173	0.9931
30	50	1.36	7.8176	0.2303	0.9853
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Newtonian approximation **Aproximación Newtoniana**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE	
5	10	0.7067	0.4332	0.9659	2.3439	1200.296
5	20	0.3891	0.9188	0.9481	2.3439	1200.296
5	30	0.6878	0.3724	0.9478	2.3439	1200.296
5	40	1.0721	0.3214	0.9315	2.3439	1200.296
5	50	1.3913	0.2519	0.7569	2.3439	1200.296
10	10	4.4063	0.352	0.9868	3.7176	118.9848
10	20	5.2108	0.3263	0.9939	2.3439	150.0379
10	30	5.1491	0.3172	0.9945	2.3439	150.0379
10	40	4.7847	0.2919	0.993	2.3439	600.1493
10	50	4.5617	0.2762	0.9953	2.3439	600.1493
14	10	6.365	0.0925	0.9252	0.8898	455.6869
14	20	6.6555	0.0686	0.9282	0.8898	455.6869
14	30	6.3282	0.0649	0.9207	0.8898	455.6869
14	40	6.6198	0.0478	0.9039	0.8898	455.6869
14	50	6.7961	0.0431	0.9087	0.8898	455.6869
20	10	7.8376	0.155	0.9797	0.8898	455.6869
20	20	7.5019	0.1315	0.9637	0.8898	455.6869
20	30	7.5548	0.117	0.9556	0.8898	455.6869
20	40	7.2574	0.1072	0.9396	0.8898	455.6869
20	50	6.8934	0.0535	0.9798	0.8898	455.6869
30	10	16.3069	0.2231	0.9992	0.8898	455.6869
30	20	13.6364	0.2306	0.9998	0.8898	455.6869
30	30	12.2647	0.2271	0.9987	0.8898	455.6869
30	40	10.86	0.2076	0.9922	0.8898	455.6869
30	50	10.1424	0.2113	0.9839	0.8898	455.6869
CONCENTRATION °BRIX	**TEMPERATURE °C**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**	**s-1**	

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Newtonian approximation **Aproximación Newtoniana**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R
5	10	1.9966	0.0172	0.9963
5	20	2.2951	0.0167	0.9685
5	30	1.6196	0.0111	0.9974
5	40	2.1978	0.012	0.9837
5	50	2.4011	0.0102	0.09318
10	10	8.5984	0.1404	0.9471
10	20	9.227	0.137	0.974
10	30	8.9023	0.1296	0.9774
10	40	10.9812	0.0358	0.8613
10	50	9.7534	0.032	0.8897
14	10	7.4836	0.012	0.9408
14	20	7.4472	0.0091	0.9677
14	30	7.0353	0.0081	0.963
14	40	7.1452	0.0059	0.9671
14	50	7.2807	0.0054	0.9708
20	10	10.4492	0.0296	0.9365
20	20	9.4671	0.023	0.9481
20	30	9.2446	0.02	0.9568
20	40	8.6762	0.0177	0.9658
20	50	7.6137	0.0058	0.8952
30	10	26.5779	0.0933	0.8675
30	20	22.3531	0.0863	0.8893
30	30	19.819	0.0771	0.8956
30	40	16.8047	0.0581	0.8727
30	50	15.4682	0.0607	0.9107
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCTY COEFFICIENT Pas n**	**CORRELATION COEFFICIENT**

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Newtonian approximation **Aproximación Newtoniana**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R
5	10	0.2	0.5973	0.4572	0.9699
5	20	0.23	0.7817	0.4114	0.951
5	30	0.16	0.5905	0.3927	0.9519
5	40	0.22	0.9271	0.3398	0.9363
5	50	0.24	1.2223	0.2641	0.7429
10	10	0.86	3.773	0.378	0.9878
10	20	0.92	4.4768	0.3513	0.9946
10	30	0.89	4.4383	0.3411	0.9958
10	40	1.1	3.9212	0.3201	0.9928
10	50	0.98	3.7857	0.3018	0.9955
14	10	0.1014	5.6324	0.1014	0.9244
14	20	0.74	5.9247	0.0752	0.93
14	30	0.7	5.6363	0.0712	0.9225
14	40	0.71	5.9168	0.0525	0.9054
14	50	0.73	6.074	0.0475	0.91
20	10	1.04	6.8606	0.1689	0.9816
20	20	0.95	6.6032	0.1432	0.9659
20	30	0.92	6.6703	0.1275	0.9578
20	40	0.87	6.4236	0.1168	0.9418
20	50	0.76	6.1389	0.0589	0.4805
30	10	2.66	13.8387	0.2453	0.9985
30	20	2.23	11.5782	0.253	0.9995
30	30	1.98	10.448	0.2487	0.9989
30	40	1.68	9.3076	0.2273	0.9931
30	50	1.55	8.7289	0.2303	0.9853
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Krieger method **Aproximación de Krieger**

Power Law model **Ley de la potencia**

BRIX	TEMP.	COEF. DE CONSIST.	INDICE FLUJO	R	SHEAR RATE	
CONCENTRATION °BRIX	TEMPERATURE °C	CONSISTENCY COEFFICIENT Pas n	FLOW BEHAVIOR INDEX (Dimensionless)	CORRELATIONM COEFFICIENT	s-1	
10	10	4.4387	0.3462	0.9878	3.7187	123.7937
10	20	4.89	0.3358	0.9953	2.8112	139.4621
10	30	4.7708	0.3299	0.9956	2.8112	139.4621

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Krieger method **Aproximación de Krieger**

Bingham Model **Modelo Bingham**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	R
CONCENTRATION °BRIX	TEMPERATURE °C	YIELD STRESS Pa	CONSISTENCTY COEFFICIENT Pas n	CORRELATION COEFFICIENT
10	10	8.5731	0.1348	0.9523
10	20	9.1459	0.1293	0.9749
10	30	8.814	0.1224	0.978

(Miranda, 1988)

Rheological Data: **PRODUCT APRICOT PUREE 0.50 mm**

Información Reológica: **PRODUCTO DAMASCO 0,50 mm**

Krieger method **Aproximación de Krieger**

Herschel-Burkley Model **Modelo Herschel-Burkley**

BRIX	TEMP.	UMBRAL FLUENCIA	COEF. CONSIST.	INDICE FLUJO	R
10	10	0.87	3.797	0.372	0.9888
10	20	0.91	4.1869	0.3612	0.996
10	30	0.88	4.0958	0.3545	0.9967
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**CORRELATION COEFFICIENT**

(Miranda, 1988)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

QUINCE PUREE
(CHILEAN PRODUCT)

CONCENTRADO MEMBRILLO
PRODUCTO CHILENO

The simples were fro chilean industrial food production installed in different climatic contourn.

Las muestras provienen de industrias chilenas ubicadas en condiciones climáticas diferentes

Rheological Data: **PRODUCT QUINCE PUREE**

Información Reológica: **PRODUCTO CONCENTRADO MEMBRILLO**

Single shear approximation **Aproximación simple**

Power Law model **Ley de la potencia**

BRIX	T'	COEF. DE CONSIST.	INDICE FLUJO	R2	SHEAR RATE	
10	5	20.8018	0.2052	0.9094	0.834	301.97
10	10	13.9207	0.2681	0,8545	0,834	301,97
10	20	12.2016	0.2484	0.7987	0.834	301.97
10	30	11.2391	0,2416	0.968	0,834	301.97
10	40	10.8352	0.2387	0.9777	0.834	301,97
10	50	11.2462	0.2169	0.9651	0.834	301.97
10	60	11.5834	0.1751	0.9639	0,834	301,97
10	70	11.39678	0.1801	0,9405	0.834	301.97
12	5	32.0569	0.2523	0,9616	0.834	301.97
12	10	23.4267	0.2852	0.8535	0.834	301,97
12	20	17.7775	0.2988	0.9826	0.834	301.97
12	30	13.583	0.2974	0.9837	0.834	301.97
12	40	10.2661	0,3286	0,9665	0.834	301.97
12	50	8,3929	0.3099	0,8691	0.834	301.97
12	60	5,8387	0.3819	0.9852	0.834	301.97
14	5	53.7048	0.2204	[illegible]	[illegible]	[illegible]
14	10	53.1535	0.225	0,9872	0,834	301.97
14	20	39.0239	0.2605	0.9922	0.834	301.97
14	30	28.9613	0.2788	0.9896	0.834	301.97
14	40	19.9149	0.3147	0.9896	0.834	301,97
14	50	16.2524	0.3114	0.9814	0,834	301.97
14	60	13,9222	0,3153	0,9793	0.834	301.97
19	5	292.1681	0.0725	0.8991	0.834	301.97
19	10	239.7612	0,103	0.8988	0.834	301.97
19	20	177,4238	0,1484	0.9325	0.834	301.97
19	30	135.4767	0,1752	0.9649	0.834	301.97
19	40	122,3017	0,1742	0,9113	0.834	301.97
19	50	98.8174	0.1908	0.9225	0.834	301.97
19	60	71.5493	0.2263	0.9909	0.834	301.97
19	70	65.1436	0.246	0.8062	0.834	301,97
CONCENTRATION °BRIX	**TEMPERATURE °C**	**CONSISTENCY COEFFICIENT Pas n**	**FLOW BEHAVIOR INDEX (Dimensionless)**	**REGRESSION COEFFICIENT**	**s-1**	

(Madrid, 1990)
(Corbalán, 1991)

Rheological Data: **PRODUCT QUINCE PUREE**

Información Reológica: **PRODUCTO CONCENTRADO MEMBRILLO**

Newtonian approximation **Aproximación Newtoniana**

Power Law model **Ley de la potencia**

°BRIX	T°	COEF. DE CONSIST.	INDICE FLUJO	R2	SHEAR RATE	
10	5	22.9287	0.2052	0.9094	0.8898	322.18
10	10	15.5052	0.2681	0.8545	0.8898	322.18
10	20	13.6078	0.2484	0.7987	0.8898	322.18
10	30	12.54	0.2416	0.968	0.8898	322.18
10	40	12.0916	0.2387	0.9777	0.8898	322.18
10	50	12.5679	0.2169	0.9651	0.8898	322.18
10	60	12.9799	0.1751	0.9639	0.8898	322.18
10	70	12.7666	0.1801	0.9405	0.8898	322.18
12	5	35.7424	0.2523	0.9616	0.8898	322.18
12	10	26.0643	0.2852	0.8535	0.8898	322.18
12	20	19.7615	0.2988	0.9826	0.8898	322.18
12	30	15.1004	0.2974	0.9837	0.8898	322.18
12	40	11.3898	0.3286	0.9665	0.8898	322.18
12	50	9.3229	0.3099	0.8691	0.8898	322.18
12	60	6.4555	0.3819	0.9862	0.8898	322.18
14	5	60.0028	0.2204	0.9664	0.8898	322.18
14	10	59.3692	0.225	0.9872	0.8898	322.18
14	20	43.4873	0.2605	0.9922	0.8898	322.18
14	30	32.2355	0.2788	0.9896	0.8898	322.18
14	40	22.1147	0.3147	0.9896	0.8898	322.18
14	50	18.0515	0.3114	0.9814	0.8898	322.18
14	60	15.4595	0.3153	0.9793	0.8898	322.18
19	5	329.5764	0.0725	0.8991	0.8898	322.18
19	10	269.9257	0.103	0.8988	0.8898	322.18
19	20	299.1588	0.1484	0.9325	0.8898	322.18
19	30	151.8091	0.1752	0.9649	0.8898	322.18
19	40	137.0612	0.1742	0.9113	0.8898	322.18
19	50	110.7076	0.1908	0.9225	0.8898	322.18
19	60	79.9095	0.2263	0.9909	0.8898	322.18
19	70	72.6626	0.246	0.8062	0.8898	322.18

CONCENTRATION °BRIX	TEMPERATURE °C	CONSISTENCY COEFFICIENT Pas n	FLOW BEHAVIOR INDEX (Dimensionless)	REGRESSION COEFFICIENT		s-1

(Madrid, 1990)
(Corbalán, 1991)

Rheological Data: **PRODUCT QUINCE PUREE**

Información Reológica: **PRODUCTO CONCENTRADO MEMBRILLO**

Single shear approximation **Aproximación simple**

Bingham Model **Modelo Bingham**

'BRIX	T'	UMBRAL FLUENCIA	COEF. CONSISTEN	R)	SHEAR RATE	
10	5	28.0919	0.1937	0.9619	0.834	301.97
10	10	22.6048	0,1885	0.9458	0.834	301.97
10	20	18.5028	0.1648	0,9366	0.834	301.97
10	30	16.6327	0.134	0.9604	0.834	301.97
10	40	16.1248	0.1226	0,9483	0.834	301.97
10	50	15.9875	0,1102	0,9503	0.834	301.97
10	60	15.588	0.0743	0.9245	0.834	301,97
10	70	15.4001	0.0789	0,9202	0.834	301.97
12	5	51.5439	0,3507	0,9004	0.834	301.97
12	10	40.2868	0.3433	0.9247	0.834	301.97
12	20	31.0676	0.2752	0.931	0.834	301.97
12	30	23,3837	0,2139	0.9391	0.834	301.97
12	40	18,1758	0.1975	0,9397	0,834	301.97
12	50	14.3435	0.1711	0.9204	0.834	301.97
12	60	12.318	0.1509	0,9365	0,834	301,97
14	5	80.7013	0.4626	0,9007	0.834	301.97
14	10	81.0754	0.4587	0.9026	0.834	301.97
14	20	64.1557	0.4371	0.9061	0.834	301.97
14	30	49.4152	0.3717	0,9117	0.834	301.97
14	40	37,0313	0.3208	0.9055	0.834	301.97
14	50	29.64452	0.2632	0.923	0.834	301,97
14	60	25.538	0.233	0.9272	0.834	301.97
19	5	327.9357	0.5745	0.9	0.834	301.97
19	10	281.8979	0.7653	0.918	0,834	301,97
19	20	232.8056	0,7918	0.8641	0.834	301.97
19	30	186.904	0.7803	0.8831	0.834	301,97
19	40	169.895	0,6895	0.8492	0.834	301.97
19	50	141,4057	0.6568	0.8688	0.834	301,97
19	60	107.2802	0,6673	0,9213	0.834	301.97
19	70	131.2683	0.4737	0.2204	0.834	301,97

CONCENTRATION °BRIX
TEMPERATURE °C
YIELD STRESS Pa
CONSISTENCTY COEFFICIENT Pas n
REGRESSION COEFFICIENT

(Madrid, 1990)
(Corbalán, 1991)

Rheological Data: **PRODUCT QUINCE PUREE**

Información Reológica: **PRODUCTO CONCENTRADO MEMBRILLO**

Newtonian approximation **Aproximación Newtoniana**

Bingham Model **Modelo Bingham**

BRIX	T°	UMBRAL FLUENCIA	COEF. CONSISTEN	R2	SHEAR RATE	
10	5	31.8379	0.2058	0.9619	0.8898	322.18
10	10	25.6192	0.2002	0.9458	0.8898	322.18
10	20	20.9702	0.175	0.9366	0.8898	322.18
10	30	18.8507	0.1423	0.9604	0.8898	322.18
10	40	18.275	0.1302	0.9483	0.8898	322.18
10	50	18.1194	0.1171	0.9503	0.8898	322.18
10	60	17.6667	0.0789	0.9245	0.8898	322.18
10	70	17.4537	0.0838	0.9202	0.8898	322.18
12	5	58.4173	0.3725	0.9004	0.8898	322.18
12	10	45.6591	0.3647	0.9247	0.8898	322.18
12	20	35.2105	0.2923	0.931	0.8898	322.18
12	30	26.5019	0.2272	0.9391	0.8898	322.18
12	40	21.5063	0.2098	0.9397	0.8898	322.18
12	50	16.2563	0.1818	0.9204	0.8898	322.18
12	60	13.9606	0.1603	0.9365	0.8898	322.18
14	5	91.4629	0.4914	0.9007	0.8898	322.18
14	10	91.8868	0.4872	0.9026	0.8898	322.18
14	20	72.7109	0.4643	0.9061	0.8898	322.18
14	30	56.0048	0.3948	0.9117	0.8898	322.18
14	40	41.9615	0.3408	0.9055	0.8898	322.18
14	50	33.5984	0.2796	0.923	0.8898	322.18
14	60	28.9435	0.2475	0.923	0.8898	322.18
19	5	371.6663	0.6102	0.9	0.8898	322.18
19	10	319.4893	0.103	0.8988	0.8898	322.18
19	20	263.8505	0.8411	0.8641	0.8898	322.18
19	30	211.8278	0.8288	0.8831	0.8898	322.18
19	40	192.5507	0.7324	0.8492	0.8898	322.18
19	50	160.2623	0.6976	0.8688	0.8898	322.18
19	60	121.5861	0.7088	0.9213	0.8898	322.18
19	70	148.7731	0.5032	0.2204	0.8898	322.18

CONCENTRATION °BRIX
TEMPERATURE °C
YIELD STRESS Pa
CONSISTENCTY COEFFICIENT Pas n
REGRESSION COEFFICIENT

(Madrid, 1990)
(Corbalán, 1991)

Rheological Data: **PRODUCT QUINCE PUREE**

Información Reológica: **PRODUCTO CONCENTRADO MEMBRILLO**

Single shear approximation **Aproximación simple**

Herschel-Burkley Model **Modelo Herschel-Burkley**

'BRIX	T'	UMBRAL FLUENCIA	COEF. CONSISTEN	n	R2	SHEAR RATE	
10	5	2.81	17.9366	0.222	0.9506	0.834	301,97
10	10	2.26	9.3771	0.3484	0.5696	0.834	301,97
10	20	1.85	10.497	0.2654	0.7185	0.834	301.97
10	30	1.66	9.7217	0,2622	0.9681	0.834	301,97
10	40	1.61	9.3628	0.2594	0,9789	0.834	301.97
10	50	1,6	9.7799	0.2353	0.9661	0.834	301.97
10	60	1.56	10.1003	0.19914	0.9638	0.834	301,97
10	70	1.54	9.9342	0.1966	0.9397	0,834	301,97
12	5	5.15	27.1764	0.2776	0.9574	0,834	301,97
12	10	4.03	17.5613	0.3338	0.6136	0.834	301,97
12	20	3.11	14,8954	0,3284	0.9774	0.834	301,97
12	30	2.34	11.4238	0.3261	0.9794	0,834	301,97
12	40	1.9	8.4298	0.364	0.9511	0.834	301.97
12	50	1.43	7.1453	0,3335	0,8491	0,834	301.97
12	60	1,23	4.7169	0.4222	0,9807	0.834	301.97
14	5	8.07	46.0905	0.2417	0.9653	0,834	301,97
14	10	8.11	45.4564	0,2474	0.9843	0.834	301,97
14	20	6.42	33,0295	0.2864	0,9894	0.834	301,97
14	30	4.94	24.3579	0,3068	0.9863	0.834	301,97
14	40	3.7	16.5041	0.347	0.9858	0,834	301,97
14	50	2.96	13.4746	0.3437	0,9743	0.834	301,97
14	60	2.55	11,5297	0,3481	0.9733	0.834	301,97
19	5	32.79	259.6933	0.0798	0.8984	0,834	301.97
19	10	28.19	212.1832	0,1129	0,8984	0.834	301.97
19	20	23,28	154.5479	0,1637	0,9293	0.834	301.97
19	30	18.69	117.4348	0.1926	0.9627	0,834	301.97
19	40	16,99	105,6204	0.1923	0,9071	0,834	301.97
19	50	14.14	85.1208	0,2104	0,9187	0,834	301.97
19	60	10.73	61.5778	0,2473	0.9906	0,834	301.97
19	70	13.13	52.4975	0.2788	0,8258	0,834	301.97

CONCENTRATION °BRIX

TEMPERATURE °C

YIELD STRESS Pa

CONSISTENCY COEFFICIENT Pas n

REGRESSION COEFFICIENT

(Madrid, 1990)
(Corbalán, 1991)

Rheological Data: **PRODUCT QUINCE PUREE**

Información Reológica: **PRODUCTO CONCENTRADO MEMBRILLO**

Newtonian approximation **Aproximación Newtoniana**

Herschel-Burkley Model **Modelo Herschel-Burkley**

'BRIX	T'	UMBRAL FLUENCIA	COEF. CONSISTEN	n	R?	SHEAR RATE	
10	5	3.18	20.038	0.222	0.9506	0.8898	322.18
10	10	2.56	10.3913	0.3484	0.5697	0.8898	322.18
10	20	2.1	11.6939	0.2654	0.7185	0.8898	322.18
10	30	1.89	10.8324	0.2622	0.9681	0.8898	322.18
10	40	1.83	10.4344	0.2594	0.9789	0.8898	322.18
10	50	1.81	10.9163	0.2353	0.9661	0.8898	322.18
10	60	1.77	11.3061	0.1914	0.9638	0.8898	322.18
10	70	1.75	11.1163	0.1966	0.9397	0.8898	322.18
12	5	5.84	30.2512	0,2776	0.9574	0.8898	322.18
12	10	4.57	19.4771	0.3338	0.6136	0.8898	322.18
12	20	3.52	16.5258	0.3284	0.9774	0.8898	322.18
12	30	2.65	12.6764	0.3261	0.9794	0.8898	322.18
12	40	2.15	0.93311	0.364	0.9511	0,8898	322.18
12	50	1.63	7.9249	0.3335	0.8491	0.8898	322.18
12	60	1.4	5.2016	0.4222	0,9807	0.8898	322.18
14	5	9,15	51.4246	0,2417	0.9635	0.8898	322.18
14	10	9.19	50.6983	0.2474	0.9843	0.8898	322,18
14	20	7.27	36.7454	0.2064	0.9894	0,8898	322,18
14	30	5.6	27.0625	0.3068	0.9863	0.8898	322.18
14	40	4.2	18.1888	0.347	0.9858	0.8898	322.18
14	50	3.36	14.935	0.3437	0.9743	0.8898	322.18
14	60	2.89	12.935	0.3481	0.9733	0.8898	322,18
19	5	37.17	292.8642	0.0798	0.8984	0,8898	322.18
19	10	31.95	238.725	0.1129	0.8984	0,8898	322,18
19	20	26.39	173.3084	0.1637	0.9293	0.8898	322.18
19	30	21.18	131.4432	0.1926	0.9627	0.8898	322.18
19	40	19.26	118,2217	0.1923	0.9071	0,8898	322.18
19	50	16.03	95.1649	0.2104	0.9187	0.8898	322.18
19	60	12.16	68.6791	0,2473	0,9306	0.8898	322.18
19	70	14.88	58.4325	0.2788	0.8258	0.8898	322.18
CONCENTRATION °BRIX	**TEMPERATURE °C**	**YIELD STRESS Pa**	**CONSISTENCY COEFFICIENT Pas n**		**REGRESSION COEFFICIENT**		

(Madrid, 1990)
(Corbalán, 1991)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

PRUNUS PUREE
(CHILE)

CONCENTRADO DE CIRUELA
CHILE

The prunus concentrate (*Prunus domestica*) sample was obtained from hot break process (30-32°Brix). The screen size finisher was $5*10^{-4}$ m.

Las muestras estudiadas proceden de pulpa concentrada con un proceso “hot break” de ciruela *Prunus domestica* de 30- 32°Brix. El tamizado de la pulpa se realizó con una malla de diámetro $5*10^{-4}$ m.

Rheological measurements

Backextrusion method

Universal testing machine (Lloyd LR-5K, Lloyd Scientific Instruments, Hampshire England) was used with 500 N cell for backextrusion tests. The poolish aluminium rod diameter was $1.26*10^{-2} \pm 0.01*10^{-2}$ m and the glass cylinder diameter was $1.84*10^{-2} \pm 0.01*10^{-2}$ m.

Viscometer.

The rheological data have been collected using a concentric cylinder Haake (RS-100) sensor ISO 3219/DIN 53019 Z20 DIN

Medidas reológicas

Retroextrusión

Se utilizó una máquina universal para prueba de materiales (Lloyd LR-5K) para los ensayos de retroextrusión, equipada con una celda de 500 N. Se utilizó un pistón de aluminio de superficie lisa con un radio de $1,26*10^{-2} \pm 0,01*10^{-2}$ m y un cilindro de vidrio graduado de radio $1,84*10^{-2} \pm 0,01*10^{-2}$ m.

Viscosimetría

Los ensayos realizados con la geometría de cilindros coaxiales se realizaron en el reómetro Haake RS-100. Se seleccionó el sensor ISO 3219/DIN 53019 Z20 DIN (Haake, 1994).

BACKEXTRUSION RESULTS

Resultados Retroextrusión

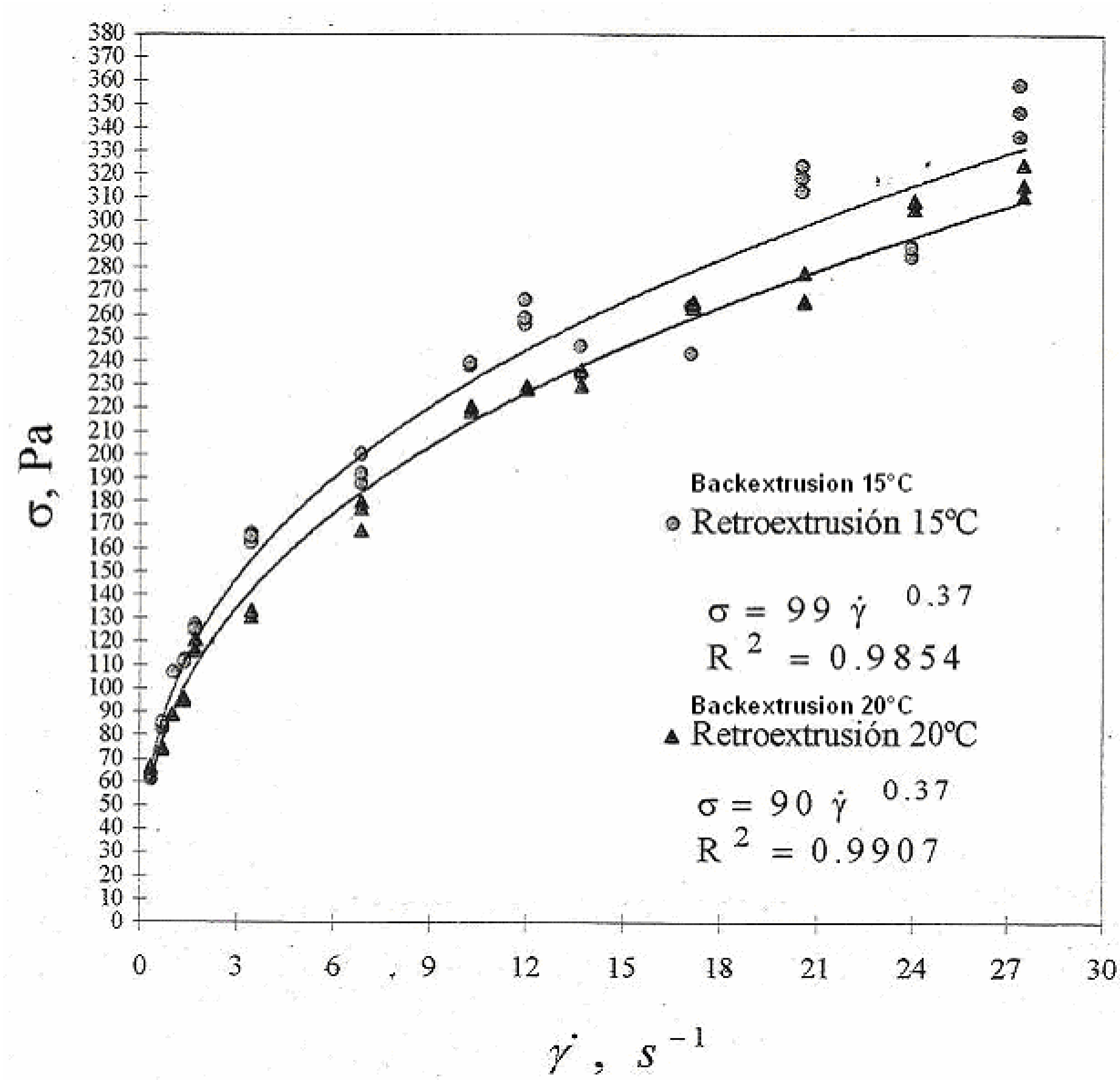


Fig. 1 . Rheogram for Prunus puree applying backextrusion at 15 and 20°C.

Fig. 1. Reograma del concentrado de ciruela obtenido con la técnica de retroextrusión a 15 y 20°C.

(Pavisic, 1997)

CONCENTRIC CYLINDER RESULTS

Reometría de cilindros coaxiales

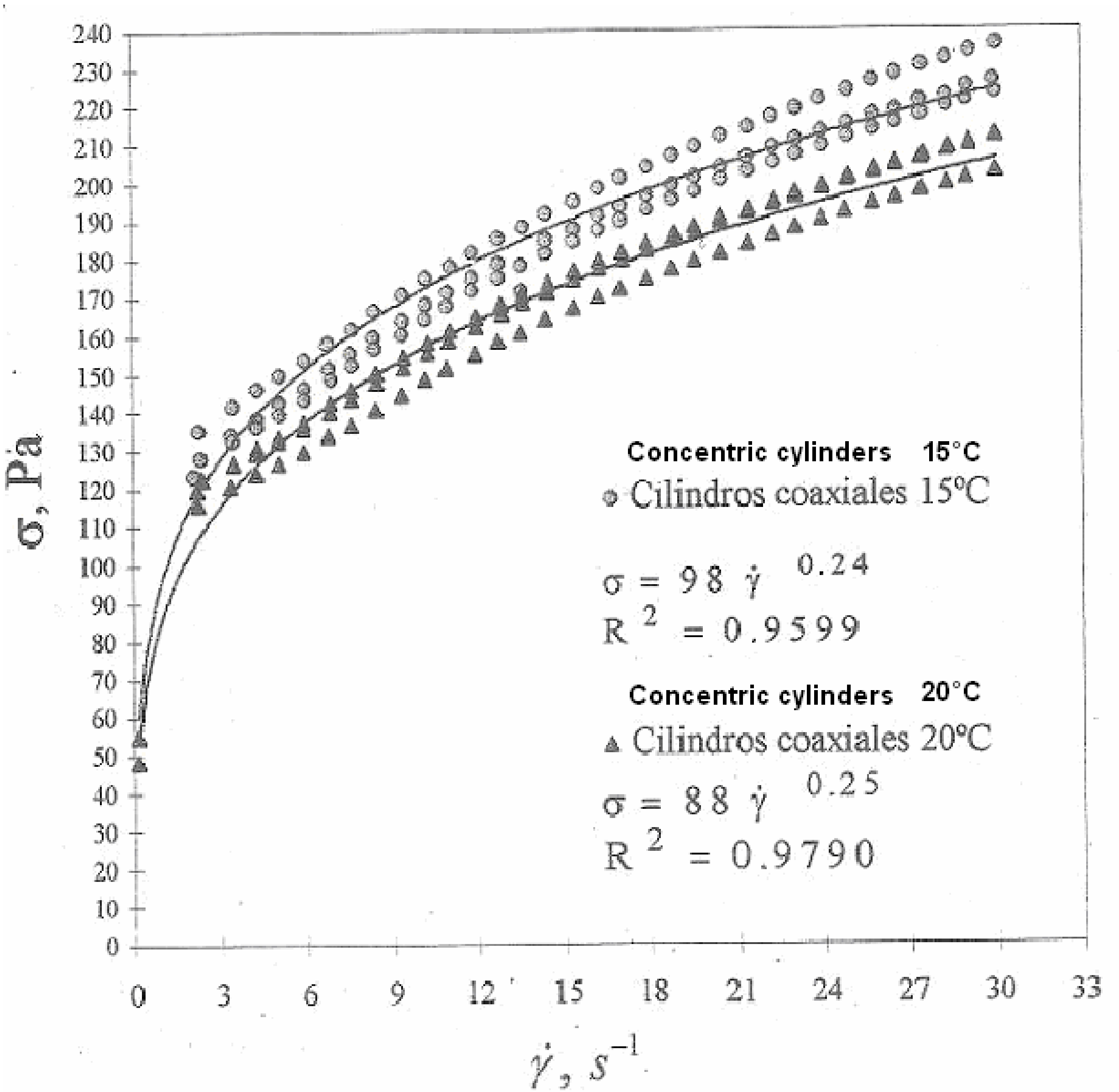


Fig. 2 . Rheogram for Prunus puree applying concentric cylinder rheometer at 15 and 20°C.

Fig.2. Reograma del concentrado de ciruela obtenido con la reometría de cilindros coaxiales a 15 y 20°C.

(Pavisic, 1997)

CONCENTRIC CYLINDER RHEOMETRY EXPERIMENTAL VALUES

Valores experimentales obtenidos con la geometría de cilindros coaxiales

Concentric cylinders, 15°C		Concentric cylinders, 20°C	
Cilindros coaxiales, 15°C		Cilindros coaxiales, 20°C	
$\dot{\gamma}$, s^{-}	$\sigma_{95\%}$, Pa	$\dot{\gamma}$, s^{-1}	$\sigma_{95\%}$, Pa
		0,13	51 ± 5
2,19	129 ± 7	2,26	119 ± 4
3,37	136 ± 5	3,43	125 ± 4
4.25	140 ± 6	4,26	128 ± 4
5,02	144 ± 6	5,02	131 ± 4
5.92	148 ± 6	5.92	134 ± 5
6.78	153 ± 5	6,81	139 ± 5
7,58	156 ± 5	7,59	142 ± 5
8.39	161 ± 6	8.48	146 ± 6
9,34	165 ± 6	9,38	150 ± 6
10.20	169 ± 6	10,27	154 ± 6
11.00	172 ± 6	11,01	157 ± 6
11,84	176 ± 6	11,96	161 ± 6
12.74	180 ± 6	12.81	164 ± 6
13.53	179 ± 10	13,56	167 ± 6
14.41	186 ± 6	14.46	170 ± 6
15.32	189 ± 6	15,35	173 ± 6
16.22	192 ± 6	16,25	176 ± 6
16,99	195 ± 6	17,03	178 ± 6
17,89	198 ± 6	17,90	180 ± 6
18.79	200 ± 7	18,82	183 ± 5
19,56	203 ± 7	19,58	185 ± 6
20.46	205 ± 7	20.46	187 ± 6
21,35	208 ± 7	21,38	190 ± 6
22,22	210 ± 7	22,28	192 ± 6
23,04	212 ± 7	23.04	194 ± 6
23,90	214 ± 7	23,97	196 ± 5
24,84	217 ± 7	24,82	198 ± 5
25,68	219 ± 7	25,73	200 ± 6
26,47	221 ± 8	26,51	202 ± 6
27,37	223 ± 7	27,43	204 ± 6
28.24	225 ± 7	28,33	205 ± 6
29,02	226 ± 7	29,06	207 ± 6
29,94	228 ± 8	29,99	209 ± 6

(Pavisic, 1997)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

ORGANIC SOYBEAN YOGURTH

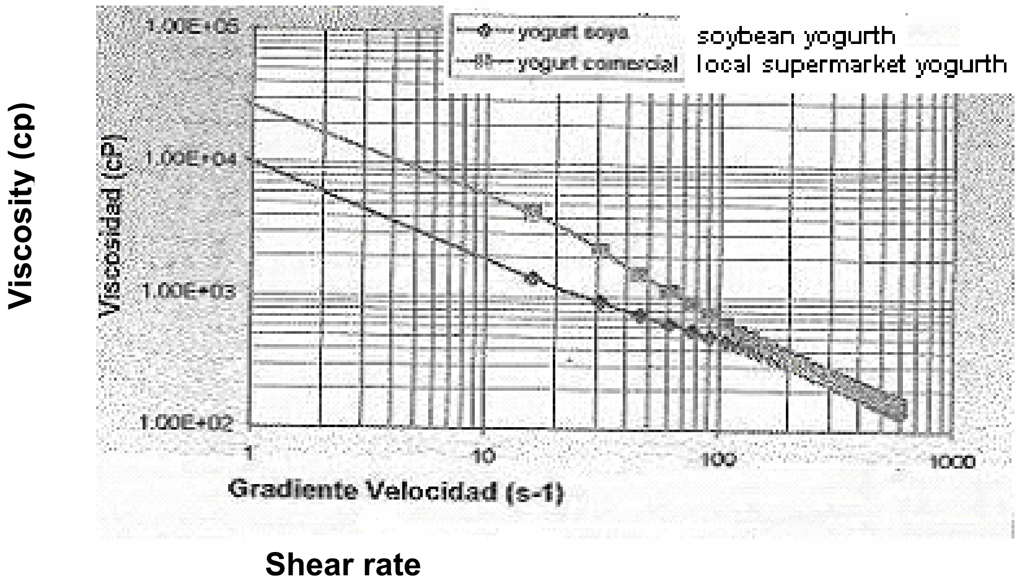
YOGURT DE SOYA ORGANICA

Oscilatory testing, strain and frecuency sweep and static rheological data have been collected using a Haake RS-100 (Haake Rheostress Mess – Technick u Co.,Karlshuhe Germany) rheometer (Flores,2002).

La pruebas reológicas dinámicas (barridos de deformación y frecuencia) y estáticas se realizaron en el Reoviscosímetro (Haake Rheostress Mess – Technick u Co.,Karlshuhe Alemania) (Flores,2002).

STEADY RHEOLOGY

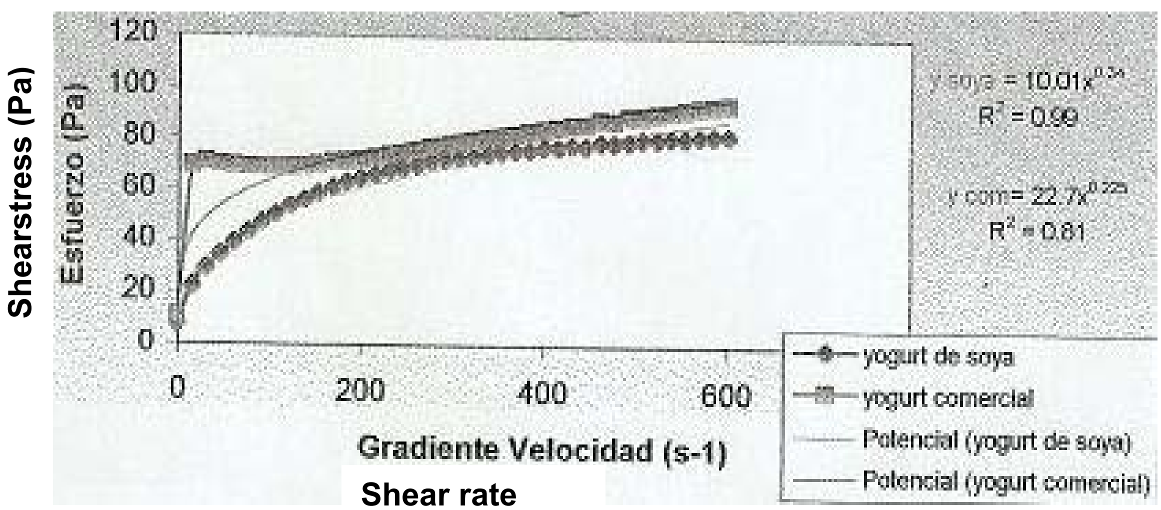
Reología Estacionaria



(Flores, 2002)

Fig 3. Apparent viscosity of soybean yogurth and local supermarket yogurth

Fig 3. Curva gradiente de velocidad versus viscosidad aparente yogurt de soya y yogurt comercial.



(Flores, 2002)

Fig.4. Rheogram for soybean yogurth and local supermarket yogurt

Fig.4. Curva de flujo yogurt de soya versus yogurt comercial

OSCILLATORY RHEOLOGY

Reología Dinámica

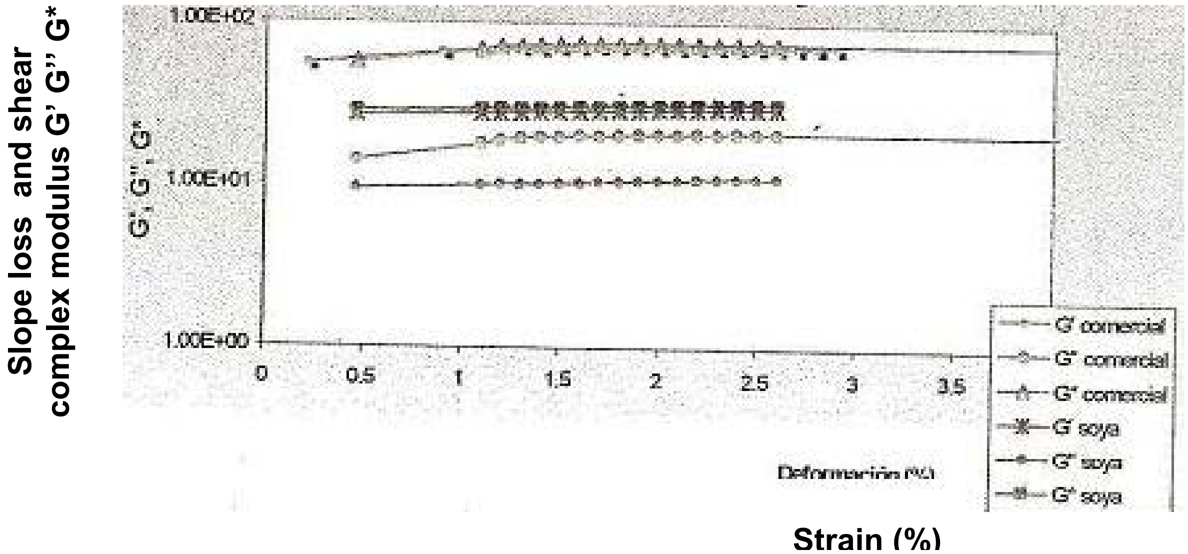
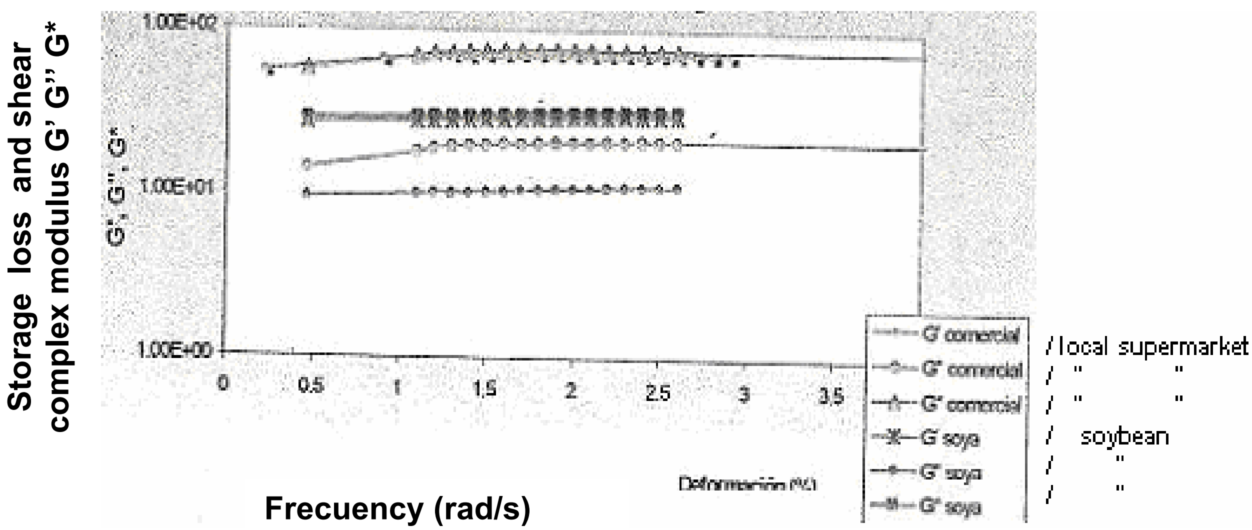


Fig.5. Strain sweep of soybean and local super market yogurt

Fig.5. Barrido de deformación de yogurt de soya versus yogurt batido comercial

(Flores, 2002)



(Flores, 2002)

Fig.6. Frecuency sweep of soybean and local supermarket yogurth

Fig.6. Barrido de frecuencia de yogurt de soya versus yogurt batido comercial

RHEOLOGICAL DATA
INFORMACION REOLOGICA

SWEET MILK

MANJAR BLANCO

The rheological data was obtained by back extrusion and oscillatory testing of sweet milk produced from a local supermarket concentrated milk.

The backextrusion technique was applied to samples with thermal treatments from 1 to 8 hours (Osorio y Steffe, 1987), (Steffe y Osorio, 1987).

Los valores presentados corresponden a pruebas de retroextrusión y viscoelásticas realizadas a manjar preparado a partir de leche condensada del mercado local.

Las pruebas se realizaron a manjares con distinto tiempo de cocción (1 a 8 hrs) aplicando la metodología de retroextrusión (Osorio y Steffe, 1987), (Steffe y Osorio, 1987).

The backextrusion technique was applied at 23°C using an universal testing machine (Lloyd LR 5K) with a 500N load cell and a 0.0065 m ± 0.0001 road diameter.

Viscoelastic properties were studied with a rheometer (Haake RS 100) with a cone (1°grade) and plate (diameter 0.02m).

Para la técnica de retroextrusión a 23°C se utilizó la máquina universal de pruebas de materiales (Lloyd LR 5K), equipada con una celda de 500 N. Se seleccionó un pistón macizo de superficie plana con un radio de 0,0065 m ± 0,0001.

En la aplicación de las pruebas dinámicas se utilizó un reómetro (Haake RS 100). El sensor utilizado fue del tipo cono y placa con un ángulo de 1 grado y un diámetro de 0,02 m.

Table 1. Sweet milk power law models with differents thermal treatments (tc) applying a cone and plate rheometer.

Tabla 1. Ecuaciones ajustadas para el modelo ley de la potencia para manjar con distintos tratamientos térmicos (tc), utilizando reómetro de cono y placa.

tc, hora **tc, hour**	Ecuación obtenida **Rheological models**	r^2
1	$\sigma = 26.75\ \dot{\gamma}^{0.60}$	0.98
2	$\sigma = 127.64\ \dot{\gamma}^{0.30}$	0.93
3	$\sigma = 177.82\ \dot{\gamma}^{0.25}$	0.87
4	$\sigma = 121.52\ \dot{\gamma}^{0.31}$	0.96
5	$\sigma = 265.95\ \dot{\gamma}^{0.19}$	0.80
6	$\sigma = 278.64\ \dot{\gamma}^{0.22}$	0.85
7	$\sigma = 230.47\ \dot{\gamma}^{0.23}$	0.95
8	$\sigma = 345.64\ \dot{\gamma}^{0.15}$	0.98

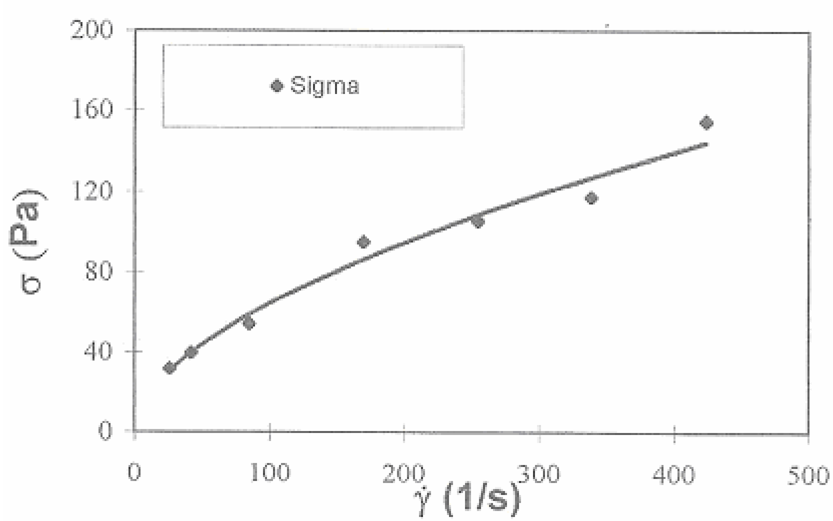


Fig 7. Rheogram with 1 h cooking time, using backextrusion methodology.

Fig 7. Reograma para muestra con tiempo de cocción de 1 hora, utilizando la técnica de retroextrusión.

Table 2. Sweet milk viscoelastic models for different cooking time.

Tabla 2. Ecuaciones G' y de G'' versus ω con respectivo valor de r^2 para cada tiempo de cocción.

tc, hora tc, hour	Ecuación para G' G' model	r^2	Ecuación para G'' G'' model	r^2
1	$G' = 4.86\ \omega^{0.58}$	0.86	$G'' = 9.50\ \omega^{0.75}$	0.98
2	$G' = 14.89\ \omega^{0.46}$	0.93	$G'' = 19.047\ \omega^{0.61}$	0.94
3	$G' = 42.64\ \omega^{0.29}$	0.84	$G'' = 36.60\ \omega^{0.48}$	0.98
4	$G' = 79.90\ \omega^{0.23}$	0.84	$G'' = 45.88\ \omega^{0.39}$	0.96
5	$G' = 102.14\ \omega^{0.23}$	0.84	$G'' = 55.04\ \omega^{0.32}$	0.93
6	$G' = 249.59\ \omega^{0.22}$	0.97	$G'' = 108.34\ \omega^{0.27}$	0.95
7	$G' = 214.75\ \omega^{0.26}$	0.76	$G'' = 107.76\ \omega^{0.30}$	0.82
8	$G' = 295.14\ \omega^{0.24}$	0.54	$G'' = 133.26\ \omega^{0.26}$	0.60

(Vargas, 1997)

Power law model obtained for 1 h cooking time:

La ecuación del modelo de la potencia para tiempo de cocción de 1 h es:

$$\sigma = 4.883\ \dot{\gamma}^{0.56} \qquad r^2 = 0.99$$

(Vargas, 1997)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

CHILEAN SUPERMARKET SWEET MILK

MANJAR BLANCO COMERCIAL

Supermarket sweet milk rheological data was obtained by backextrusion methodology (Osorio and Steffe, 1987; Steffe and Osorio 1987).

The rheological test was applied to the market packing approach to a cylinder internal radius 3.24 ± 0,01 cm and 4.10 ± 0.01 cm high (Silva,1996).

Los valores presentados corresponden a pruebas de retroextrusión realizadas a manjar blanco comercial chileno envasado en envases aproximadamente cilíndrico de radio interno 3,24 ± 0,01 cm y de 4,10 ± 0,01 cm de altura.

Se aplicó la metodología de Osorio y Steffe (1987) y Steffe y Osorio (1987) (Silva, 1996).

Table 3. Sweet milk Power law models with different °Brix.

Tabla 3. Ecuaciones ajustadas para el modelo de la Ley de la potencia para manjar blanco con diferentes contenidos de sólidos solubles.

Soluble solids content °Brix Concentración de sólidos solubles (°Brix)	**Rheological model** Ecuación obtenida	r^2
71	$\sigma = 899\ \dot{\gamma}^{0,34}$	0,1670
72	(-)	(-)
73	$\sigma = 1619\ \dot{\gamma}^{0,69}$	0,7836
74	(-)	(-)
75	(-)	(-)

(Silva, 1996)

The Osorio and Steffe (1987) does not work with sweet milk soluble solids content of 72, 74 and 75°Brix and for 71 and 73°Brix does not explain the fluid behavior.

Para los contenidos de sólidos solubles de 72, 74°Brix y 75°Brix no fue posible obtener ecuaciones según el método de Osorio y Steffe (1987). En tanto para 71° Brix y 73°Brix, y según los valores de los coeficientes de correlación obtenidos, se puede decir que el modelo de la ley de la potencia no representa bien el comportamiento del fluido.

Table 4. Sweet milk Bingham model with different soluble solids content.

Tabla 4. Ecuaciones obtenidas para el modelo de Bingham para manjar blanco con diferentes contenidos de sólidos solubles.

Soluble solids content °Brix Concentración de sólidos solubles (°Brix)	Rheological model Ecuación obtenida	r^2
71	$\sigma = 447 + 757\dot{\gamma}$	0.8362
72	$\sigma = 330 + 1422\dot{\gamma}$	0.9218
73	$\sigma = 800 + 1116\dot{\gamma}$	0.8471
74	$\sigma = 1011 + 1421\dot{\gamma}$	0.8722
75	$\sigma = 1024 + 1268\dot{\gamma}$	0.8395
76	$\sigma = 1741 + 1622\dot{\gamma}$	0.8848

(Silva, 1996)

Table 5. Plastic viscosity data of Bingham fluid with different solubles solids contents of sweet milk.

Tabla 5. Valores de viscosidad plástica (μ_{pl}) y contenido de sólidos solubles para manjar blanco del modelo de Bingham.

Soluble solids content (°Brix) Concentración de sólidos solubles (°Brix)	μ pl (Pa s)
71	955.831
72	1489.080
73	1518.234
74	1935.182
75	1934.983
76	2775.984

Plasctic viscosity data model expressed in terms of the soluble solids contents function is described by the following equation:

La ecuación que representa el comportamiento de la viscosidad plástica en función de la concentración es:

$$\mu pl = 1.97 * 10^{-22} C^{13.4} \qquad R^2=0.9110$$

(Silva, 1996)

YIELD STRESS, BINGHAM MODEL

Umbral de Fluencia, modelo Bingham

Table 6. Yield stress data of a Bingham fluid with different soluble solids content of sweet milk.

Tabla 6. Valores de umbral de fluencia (σ_o) versus concentración de sólidos solubles (°Brix) para muestras de manjar blanco.

Soluble solids (°Brix) Sólidos solubles (°Brix)	Yield stress Umbral de fluencia (Pa)
69	103.8
69	113.3
69	142.2
70	171.1
71	171.1
71	238.5
72	248.1
72	219.2
72	228.8
72	277.0
72	267.3
73	277.0
73	392.5
73	382.9
73	315.5
73	353.3
73	354.0
73	344.3
74	392.5
74	363.6
74	373.2
74	431.0
74	450.2
75	479.1
75	498.3
75	459.8
75	488.7
76	546.5
76	575.3

(Silva, 1996)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

MAYONNAISE MADE WITH MARKET CHILEAN COMPONENTS

MAYONESA ELABORADA CON INSUMOS DEL MERCADO CHILENO

Table 7. Pilot mayonnaise compositions

Tabla 7. Composición de la mayonesa elaborada

Componets **Materias primas**	**Quantity (g)** **Cantidad (g)**
Sunflower Oil Aceite de Maravilla	129.4
Egg yolk Yema de huevo fresca	15
Acetic acid solution Acido acético solution	12.8
Mustard powder Mostaza en polvo	0.8
Sugar Azúcar	1.0
Drink water Agua potable	26.6
Salt + species Sal + especias	1.5
Vegetable gum Goma vegetal	* * *

* * * 0.1; 0.2; 0.3; 0.5 %

(González, 1997)

Table 8. Guargum Mayonnaise Power law models

Tabla 8. Modelación de mayonesa elaborada con goma guar.

Concent. (%)	Modelo Model	n (-)	k (Pas^n)	r2
0.1	LEY POTENCIA Power Law	0.13	86.3	0.834
0.2	LEY POTENCIA Power Law	0.15	113.3	0.845
0.3	LEY POTENCIA Power Law	0.16	103.3	0.894
0.5	LEY POTENCIA Power Law	0.14	73.7	0.854

(González, 1997)

Table 9. Xanthan gum Mayonnaise Power law models

Tabla 9. Modelación de mayonesa elaborada con goma xantan.

Concent. (%)	Modelo Model	n (-)	k (Pas^n)	r2
0.1	LEY POTENCIA Power Law	0.14	78	0.979
0.2	LEY POTENCIA Power Law	0.16	103.7	0.929
0.3	LEY POTENCIA Power Law	0.15	83.7	0.857
0.5	LEY POTENCIA Power Law	0.17	116.7	0.895

(González, 1997)

Table 10. Xanthan-guar (50:50) Mayonnaise Power law models

Tabla 10. Modelación de mayonesa elaborada con mezcla xantan-guar en proporción 50:50.

Concent. (%)	Modelo . Model	n (-)	k (Pas^n)	r2
0.1	LEY POTENCIA Power Law	0.15	72	0.756
0.2	LEY POTENCIA Power Law	0.11	61.3	0.952
0.3	LEY POTENCIA Power Law	0.16	81	0.942
0.5	LEY POTENCIA Power Law	0.16	63.3	0.967

(González, 1997)

Table 11. Xanthan-guar (70:30) Mayonnaise Power law models

Tabla 11. Modelación de mayonesa elaborada con mezcla xantan-guar en proporción 70:30.

Concent. (%)	Modelo Model	n (-)	k (Pas^n)	r2
0.1	LEY POTENCIA Power Law	0.14	60	0.887
0.2	LEY POTENCIA Power Law	0.17	46.7	0.953
0.3	LEY POTENCIA Power Law	0.17	64.7	0.958
0.5	LEY POTENCIA Power Law	0.18	61.7	0.964

(González, 1997)

Table 12. Xanthan-guar (30:70) Mayonnaise Power law models

Tabla 12. Modelación de mayonesa elaborada con mezcla xantan-guar en proporción 30:70.

Concent. (%)	Modelo Model	n (-)	k (Pas^n)	r2
0.1	LEY POTENCIA Power Law	0.15	88.3	0.963
0.2	LEY POTENCIA Power Law	0.16	102.3	0.850
0.3	LEY POTENCIA Power Law	0.16	94.3	0.891
0.5	LEY POTENCIA Power Law	0.16	106.7	0.879

(González, 1997)

Table 13. Consistent coefficient (k) power law data for different shelf-life mayonnaise (xanthan-guar gums) at 19°C collected with a rotacional viscometer Rheostress Haake RS-100 using parallel plate (Φ 35 mm, gap 1 mm)

Tabla 13. Valores de k (modelo ley de la potencia) en función del tiempo de almacenamiento de mayonesa con goma xantan y guar obtenida a 19°C con el viscosímetro Rheostress Haake RS-100 con el sistema placa-placa (Φ 35 mm, separación 1 mm)

Goma vegetal/ vegetable gum Tpo. Almac.[día] Storage [days]	k (Pas^n)			
	Concentración Total de Gomas Vegetales (%) Full vegetal gum conc. [%]			
	0.1	0.2	0.3	0.5
30:70 X-G 3	88.3	102.3	94.3	106.7
Xantan 5	78.0	103.7	83.7	116.7
Guar 7	86.3	113.3	103.3	73.7
50:50 X-G 70	72.0	61.3	81.0	63.3
70:30 X-G 84	60.0	46.7	64.7	61.7

(González, 1997)

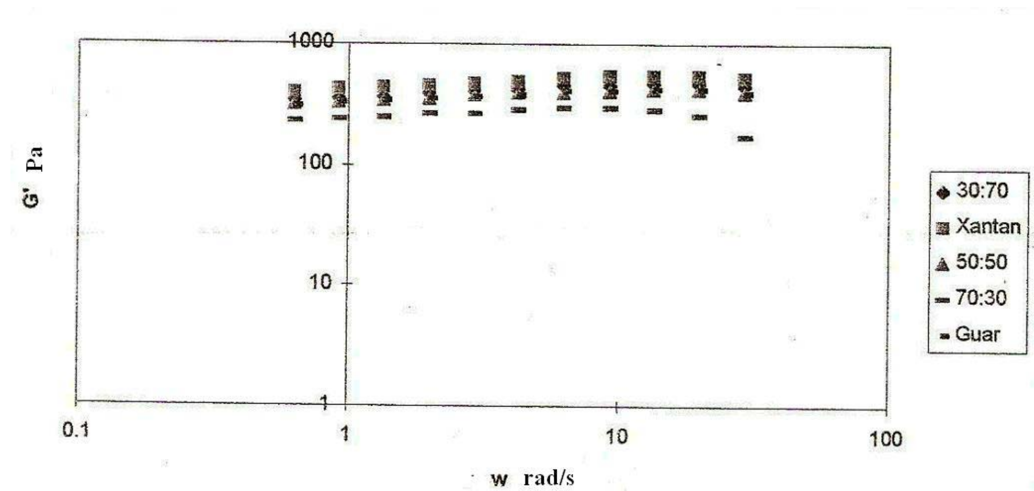


Fig.8 Frecuency sweep oscillatory data storage modulos for xanthan – guar gum mayonnaise, parallel – plate (Φ 35 mm, gap 1 mm) at 19°C.

Fig. 8 Datos oscilatorios barrido de frecuencia, módulo de almacenamiento para mayonesa con distintas proporciones de goma xantan y guar. Placas paralelas (Φ 35 mm, separación 1 mm) a 19°C.

(González, 1997)

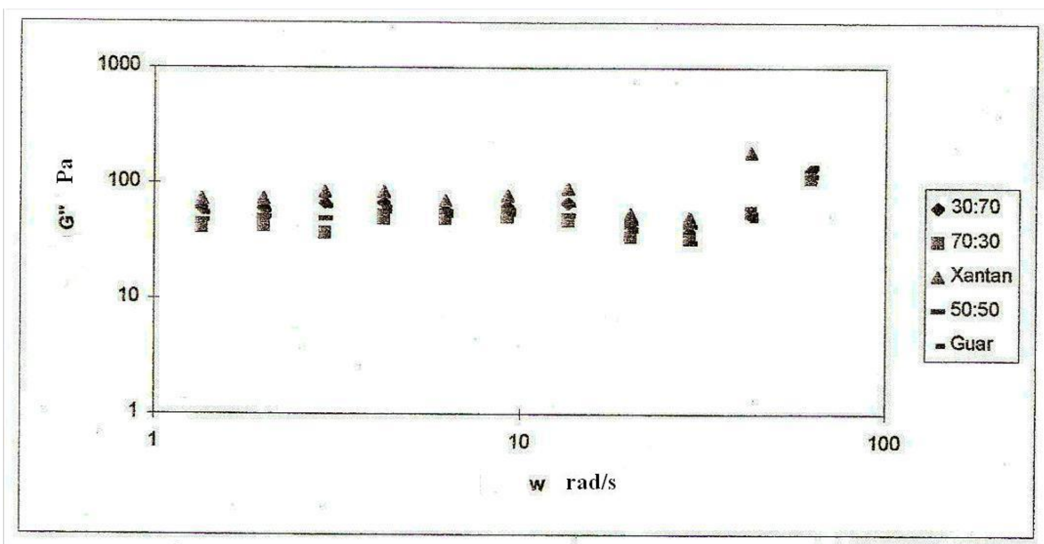


Fig. 9 Loss modulus for xanthan guar gums mayonnaise parallel plate (Φ 35 mm, gap 1 mm) at 19°C.

Fig. 9 Valores promedio, para todas las concentraciones consideradas de G" para mayonesa elaborada con los distintos tipos y proporciones de gomas vegetales en función de w, placas paralelas (Φ 35 mm, gap 1 mm) a 19°C.

(González, 1997)

RHEOLOGICAL DATA
INFORMACION REOLOGICA

CHILEAN GRAPE CONCENTRATE (PAIS VARIETY)

CONCENTRADO DE UVA (VARIEDAD PAIS) CHILENO

Grape fruti (Pais variety)

Grape juice rheological data at different soluble solid content (16,20,30,40,50,60 and 70%) and different temperatures (5,10,15,20,25,30,35,40,45 and 50 °C) were obtained.

Rheological data for grape concentrate were collected with a rotational viscometer RV-2 Haake, model FK and the Krieger method was applied for to obtain the rheological models.

Concentrado de uva (variedad Pais)

Las mediciones reológicas se realizaron a muestras de concentración 16,20,30,40,50,60 y 70% de sólidos solubles y a las temperaturas ,10,15,20,25,30,35,40,45 y 50 °C.

Las propiedades reológicas se determinaron utilizando un viscosímetro RV-2 de marca Haake con baño termorregulado, modelo FK.

Para los cálculos se utilizó la aproximación de Krieger.

Physical, chemical and microbiological data of chilean grape concentrate (Pais variety).

Características físicas, químicas y microbiológicas de zumo de uva variedad Pais del mercado chileno.

a) Soluble solids Sólidos solubles	72%
b) Total solids Sólidos totales	72%
c) pH	3.3
d) Etanol content Contenido de alcohol	0.42 %p/p (%w/w)
e)Volátil acid content Contenido de ácidos volátiles	0.003 g Acetic acid 0.003 g Ac acético/kg
f)Titrable acidity Acidez titulable	0.0001 g Tartaric acid 0.0001 g Acido tartárico
g) Reducing sugars Azucares reductores	70.45%p/p (%w/w)
h) Sulphurus anhidride Anhidrido sulfuroso	72.9 mg/kg
i) Plate count Recuento microbiológico	Total account : 2* 10^3ufc/ml Recuento total Coliformes account: absent Recuento de coliformes: no se registran Yield and mold account:absent Recuento de Hongos y levaduras
j) Relative density Densidad relativa	1.3995 g/ml

(Parra, 1991)

The rheological model applied to represent the data were Krieger method, simple, shear and newtonian approximation.
The Krieger method gives an excellent representation of experimental data.

Los modelos reológicos se obtuvieron aplicando las metodologías de Krieger, la aproximación simple y la newtoniana. La mejor correlación se obtuvo con la metodología de Krieger.

Rheological Data: **PRODUCT GRAPE JUICE (PAIS VARIETY)**
Información Reológica: **PRODUCTO JUGO DE UVA (VARIEDAD PAIS)**
Krieger method **Aproximación de Krieger**
Power Law model **Ley de la potencia**

Sólidos Totales(%)	Temperatura (°C)	k (Pa*s^n)	n (adim)	r (adim)
Total solids %	**Temperature**			
16	5	0.0032	0.9581	0.9808
16	10	0.0028	0.9617	0.9667
16	15	0.0020	0.9917	0.9690
16	20	0.0023	0.9586	0.9783
16	25	0.0017	0.9828	0.9772
16	30	0.0008	1.0800	0.9617
16	35	0.0002	1.2525	0.9402
16	40	0.0004	1.1736	0.9149
16	45	0.0005	1.1385	0.9100
16	50	0.0002	1.2099	0.9299
20	5	0.0003	1.3086	0.9889
20	10	0.0002	1.3331	0.9802

(Parra, 1991)

20	15	0.0001	1.4001	0.9874
20	20	0.0001	1.3431	0.9949
20	25	0.0000	1.5395	0.9886
20	30	0.0000	1.5984	0.9824
20	35	0.0000	1.4898	0.9963
20	40	0.0000	1.5072	0.9990
20	45	0.0000	1.6858	0.9895
20	50	0.0000	1.4386	0.9949
30	5	0.0006	1.2575	0.9899
30	10	0.0006	1.2302	0.9910
30	15	0.0004	1.2569	0.9935
30	20	0.0005	1.2203	0.9813
30	25	0.0002	1.3185	0.9943
30	30	0.0001	1.3937	0.9870
30	35	0.0000	1.5573	0.9844
30	40	0.0000	1.7551	0.9635
30	45	0.0000	1.4932	0.9939
30	50	0.0000	1.5099	0.9937
40	5	0.0108	0.9501	0.9920
40	10	0.0066	1.0001	0.9978
40	15	0.0052	1.0075	0.9968
40	20	0.0077	0.9313	0.9969
40	25	0.0017	1.1314	0.9961

(Parra, 1991)

40	30	0.0012	1.1658	0.9929
40	35	0.0012	1.1491	0.9920
40	40	0.0008	1.2028	0.9886
40	45	0.0012	1.1513	0.9890
40	50	0.0016	1.1204	0.9941
50	5	0.0064	1.1908	0.9947
50	10	0.0032	1.2518	0.9925
50	15	0.0020	1.2842	0.9892
50	20	0.0007	1.4048	0.9779
50	25	0.0016	1.2402	0.9906
50	30	0.0009	1.2908	0.9882
50	35	0.0009	1.2652	0.9892
50	40	0.0004	1.3805	0.9769
50	45	0.0005	1.3646	0.9778
50	50	0.0004	1.4295	0.9802
60	5	0.0247	1.2808	0.9821
60	10	0.0296	1.1547	0.9879
60	15	0.0197	1.1667	0.9941
60	20	0.0112	1.2089	0.9872
60	25	0.0068	1.2506	0.9931
60	30	0.0026	1.3449	0.9913
60	35	0.0022	1.3674	0.9828
60	40	0.0031	1.2957	0.9751

(Parra, 1991)

60	45	0.0022	1.3747	0.9724
60	50	0.0014	1.4623	0.9774
70	5	0.7575	1.0115	0.9967
70	10	0.4432	1.0440	0.9986
70	15	0.4392	0.9442	0.9969
70	20	0.2260	0.9852	0.9961
70	25	0.1926	0.9609	0.9973
70	30	0.2143	0.8767	0.9937
70	35	0.1460	0.9050	0.9936
70	40	0.2146	0.8742	0.9933
70	45	0.1471	0.7972	0.9814
70	50	0.0903	0.8329	0.9816
72	5	1.0427	1.0691	0.9963
72	10	1.0350	0.9682	0.9990
72	15	0.6935	0.9596	0.9992
72	20	0.2739	1.0530	0.9965
72	25	0.2363	1.0062	0.9970
72	30	0.1792	0.9716	0.9968
72	35	0.1652	0.9329	0.9950
72	40	0.1100	0.9450	0.9978
72	45	0.1172	0.8493	0.9539
72	50	0.0770	0.9064	0.9914

(Parra, 1991)

Rheological Data: **PRODUCT GRAPE CONCENTRATE (var, Pais)**

Información Reológica: **PRODUCTO CONCENTRADO DE UVA (var, Pais)**

Krieger method **Aproximación de Krieger**

Bingham Model **Modelo Bingham**

Sólidos Totales(%)	Temperatura (ºC)	τY (Pa)	ηp (Pa*s)	r (adim)
16	5	-0.1493	0.0026	0.9961
16	10	-0.1165	0.0023	0.9907
16	15	-0.4027	0.0022	0.9877
16	20	-0.2795	0.0020	0.9840
16	25	-0.3264	0.0016	0.9770
16	30	-0.4361	0.0019	0.9833
16	35	-0.4608	0.0017	0.9764
16	40	-0.2684	0.0015	0.9699
16	45	-0.2329	0.0015	0.9713
16	50	-0.3509	0.0015	0.9706
20	5	-0.4171	0.0032	0.9994
20	10	-0.3987	0.0027	0.9993
20	15	-0.5325	0.0026	0.9962
20	20	-0.6359	0.0023	0.9913
20	25	-0.7511	0.0022	0.9894
20	30	-0.7937	0.0021	0.9861

(Parra, 1991)

20	35	-0.8719	0.0020	0.9884
20	40	-0.8723	0.0019	0.9879
20	45	-0.8373	0.0018	0.9886
20	50	-0.9495	0.0018	0.9867
30	5	-0.2193	0.0044	0.9992
30	10	-0.2519	0.0038	0.9995
30	15	-0.3966	0.0033	0.9996
30	20	-0.3511	0.0028	0.9992
30	25	-0.3835	0.0027	0.9988
30	30	-0.4590	0.0025	0.9958
30	35	-0.5691	0.0024	0.9926
30	40	-0.4876	0.0023	0.9891
30	45	-0.6354	0.0023	0.9897
30	50	-0.6945	0.0022	0.9877
40	5	-0.0379	0.0085	0.9996
40	10	-0.0269	0.0067	0.9997
40	15	-0.0848	0.0057	0.9998
40	20	-0.0106	0.0049	0.9996
40	25	-0.1148	0.0043	0.9997
40	30	-0.1179	0.0039	0.9998
40	35	-0.1157	0.0035	0.9998
40	40	-0.1546	0.0033	0.9996
40	45	-0.1814	0.0037	0.9991

(Parra, 1991)

40	50	−0.1378	0.0040	0.9997
50	5	−0.2822	0.0201	0.9995
50	10	−0.2835	0.0158	0.9998
50	15	−0.2911	0.0123	0.9998
50	20	−0.3007	0.0097	0.9999
50	25	−0.3384	0.0084	0.9999
50	30	−0.3840	0.0067	0.9998
50	35	−0.3819	0.0061	0.9996
50	40	−0.3831	0.0060	0.9997
50	45	−0.3711	0.0061	0.9995
50	50	−0.3971	0.0065	0.9994
60	5	−0.3513	0.0875	0.9987
60	10	−0.1631	0.0622	0.9995
60	15	−0.1754	0.0457	0.9998
60	20	−0.2468	0.0345	0.9998
60	25	−0.3010	0.0278	0.9999
60	30	−0.3027	0.0196	0.9998
60	35	−0.3126	0.0187	0.9993
60	40	−0.3205	0.0181	0.9979
60	45	−0.3537	0.0201	0.9993
60	50	−0.3449	0.0196	1.0000
70	5	0.8059	0.7836	0.9999
70	10	0.2835	0.5529	0.9999

(Parra, 1991)

70	15	-0.4661	0.3336	1.0000
70	20	-0.4436	0.2126	0.9999
70	25	-0.4802	0.1580	0.9999
70	30	-0.2567	0.1093	0.9998
70	35	-0.2568	0.0858	0.9997
70	40	-0.2722	0.0618	0.9993
70	45	-0.1818	0.0468	0.9987
70	50	-0.2954	0.0361	0.9985
72	5	0.4712	1.4137	0.9999
72	10	-0.2865	0.9007	0.9999
72	15	-0.1766	0.5682	1.0000
72	20	1.2943	0.3603	0.9995
72	25	-0.2610	0.2471	0.9999
72	30	-0.4204	0.1577	1.0000
72	35	-0.1814	0.1156	0.9999
72	40	-0.3215	0.0832	0.9998
72	45	-1.2622	0.0613	0.9682
72	50	-0.5868	0.0485	0.9987

(Parra, 1991)

Rheological Data: **PRODUCT GRAPE CONCENTRATE (var. Pais)**

Información Reológica: **PRODUCTO CONCENTRADO UVA (var. Pais)**

Krieger method **Aproximación de Krieger**

Herschel-Burkley Model **Modelo Herschel-Burkley**

Sólidos Totales(%)	Temperatura (ºC)	τy (Pa)	k (Pa*s^n)	n (adim)	r (adim)
16	5	0.01	0.0030	0.9644	0.9809
16	10	0.01	0.0027	0.9694	0.9671
16	15	0.04	0.0016	1.0170	0.9693
16	20	0.03	0.0020	0.9776	0.9791
16	25	0.03	0.0014	1.0099	0.9776
16	30	0.04	0.0006	1.1194	0.9607
16	35	0.05	0.0000	1.4422	0.9076
16	40	0.03	0.0002	1.2608	0.8976
16	45	0.02	0.0003	1.1860	0.9007
16	50	0.04	0.0001	1.3386	0.9135
20	5	0.04	0.0001	1.4115	0.9764
20	10	0.04	0.0001	1.4377	0.9635
20	15	0.05	0.0000	1.5802	0.9668
20	20	0.06	0.0001	1.4558	0.9890
20	25	0.08	0.0000	2.2183	0.9009
20	30	0.02	0.0000	1.6990	0.9720
20	35	0.09	0.0000	1.7262	0.9854
20	40	0.09	0.0000	1.7581	0.9930

(Parra, 1991)

20	45	0.08	0.0000	2.5225	0.9029
20	50	0.09	0.0000	1.5774	0.9976
30	5	0.02	0.0009	1.2222	0.9565
30	10	0.02	0.0004	1.2891	0.9537
30	15	0.04	0.0001	1.4376	0.9722
30	20	0.04	0.0001	1.3894	0.9822
30	25	0.04	0.0001	1.3887	0.9837
30	30	0.04	0.0001	1.4708	0.9711
30	35	0.06	0.0000	1.6098	0.9679
30	40	0.05	0.0001	1.4741	0.9732
30	45	0.02	0.0000	1.8201	0.9350
30	50	0.07	0.0000	1.4882	0.9933
40	5	0.00	0.0108	0.9521	0.9924
40	10	0.00	0.0066	1.0001	0.9978
40	15	0.01	0.0048	1.0211	0.9967
40	20	0.00	0.0076	0.9326	0.9969
40	25	0.01	0.0014	1.1568	0.9946
40	30	0.01	0.0009	1.2082	0.9883
40	35	0.01	0.0009	1.1909	0.9866
40	40	0.02	0.0003	1.3230	0.9690
40	45	0.02	0.0007	1.2288	0.9696
40	50	0.01	0.0015	1.1359	0.9929

(Parra, 1991)

50	5	0.03	0.0052	1.2247	0.9923
50	10	0.03	0.0022	1.3111	0.9875
50	15	0.03	0.0013	1.3452	0.9832
50	20	0.02	0.0003	1.5334	0.9539
50	25	0.03	0.0011	1.2951	0.9838
50	30	0.04	0.0005	1.3792	0.9773
50	35	0.04	0.0005	1.3451	0.9793
50	40	0.02	0.0002	1.4746	0.9562
50	45	0.04	0.0003	1.4631	0.9628
50	50	0.04	0.0002	1.5524	0.9657
60	5	0.04	0.0184	1.3496	0.9704
60	10	0.02	0.0264	1.1792	0.9846
60	15	0.02	0.0171	1.1952	0.9919
60	20	0.02	0.0092	1.2475	0.9816
60	25	0.03	0.0048	1.3171	0.9876
60	30	0.02	0.0013	1.4669	0.9760
60	35	0.02	0.0007	1.5566	0.9459
60	40	0.02	0.0018	1.3905	0.9516
60	45	0.02	0.0013	1.4736	0.9460
60	50	0.02	0.0006	1.6282	0.9491
70	5	0.08	0.7299	1.0189	0.9962
70	10	0.03	0.4350	1.0476	0.9985
70	15	0.05	0.4275	0.9490	0.9971

(Parra, 1991)

70	20	0.04	0.2123	0.9966	0.9954
70	25	0.05	0.1791	0.9735	0.9970
70	30	0.03	0.2080	0.8817	0.9940
70	35	0.02	0.1401	0.9119	0.9935
70	40	0.03	0.1177	0.8837	0.9936
70	45	0.02	0.1425	0.8024	0.9815
70	50	0.03	0.0847	0.8430	0.9821
72	5	0.05	1.0262	1.0725	0.9961
72	10	0.03	1.0269	0.9698	0.9990
72	15	0.02	0.6885	0.9609	0.9992
72	20	0.13	0.2284	1.0856	0.9925
72	25	0.03	0.2284	1.0122	0.9966
72	30	0.04	0.1680	0.9828	0.9967
72	35	0.02	0.1604	0.9379	0.9951
72	40	0.03	0.1019	0.9580	0.9982
72	45	0.13	0.0869	0.8987	0.9576
72	50	0.06	0.0672	0.9284	0.9922

(Parra, 1991)

Table 14. Temperature grape concentrate apparent viscosity data models

Tabla 14. Ecuaciones de regresión de la viscosidad del zumo de uva en función de la temperatura.

Sample Soluble solids (%) Muestra (%S.Solubles)	Model Ecuación	r
16	$\eta = 3.0193 * \exp(-2.963e-2*T)$	-0.99
20	$\eta = 2.5930 * \exp(-4.510e-2*T)$	-0.98
30	$\eta = 3.6521 * \exp(-3.603e-2*T)$	-0.99
40	$\eta = 10.0176 * \exp(-3.704e-2*T)$	-0.99
50	$\eta = 16.1629 * \exp(-4.030e-2*T)$	-0.99
60	$\eta = 68.5182 * \exp(-3.916e-2*T)$	-0.99

(Parra, 1991)

Table 15. Temperature grapes concentrate flow index

Tabla 15. Ecuaciones de regresión del índice de flujo de zumo de uva en función de la temperatura.

Sample Soluble solids (%) Muestra (% S.Solubles)	Model Ecuación	r
70	$n=1.60 - 4.86e-3*T$	-0.9244
72	$n=1.06*\exp(-3.49e-3*T)$	-0.7753

(Parra, 1991)

Table 16. Concentration grape juice versus apparent viscosity grape concentrate (var. Pais)

Tabla 16. Ecuaciones de regresión de la viscosidad de zumo de uva en función de la concentración.

TEMPERATURE TEMPERATURA (ºC)	MODELS ECUACION	r
5	η = 3.617e-3*C^2.198	0.9131
10	η = 2.930e-3*C^2.172	0.8890
15	η = 2.430e-3*C^2.148	0.8902
20	η = 2.550e-3*C^2.100	0.8758
25	η = 1.810e-3*C^8.540	0.8753
30	η = 1.820e-3*C^8.100	0.8684
35	η = 1.270e-3*C^2.143	0.8880
40	η = 1.521e-3*C^2.050	0.8743
45	η = 1.224e-3*C^2.046	0.8623
50	η = 9.635e-4*C^2.060	0.8507

(Parra, 1991)

BIBLIOGRAPHY

BIBLIOGRAFIA

1. Corbalán Rojas, Francisco Enrique (1991). Estudio reológico de un concentrado de membrillo (Cydonia oblonga) y su dependencia de la temperatura y la concentración. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
2. Flores Guerra, Carolina Andrea.(2002). Desarrollo de yogurt de soja orgánico. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
3. González de la Parra, Ricardo Enrique.(1997) Caracterizaciónn reológica de mayonesa formulada con goma guar y goma cantan. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
4. Letelier Monzo, Ricardo Alberto (1988). Determinación de los parámetros reológicos del concentrado de tomate y su dependencia de la temperatura y la concentración. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
5. Madrid Valdés, José Miguel (1990). Propiedades reológicas de un concentrado de membrillo (Cydonia oblonga) y la utilización de los parámetros reológicos en el Dimensionamiento de una bomba para el transporte de fluidos no-newtoniano. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
6. Miranda Maldonado, Misael Lorenzo (1988). Caracterización reológica de un concentrado de damasco y su dependencia de la temperatura y la concentración. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
7. Osorio, F.A., Steffe J.F. (1987).” Back extrussion of power law fluids”. Journal of texture studies 18:43-63.

8. Parra Valdés, Ernesto Adolfo (1991). Determinación de las propiedades reológicas de un jugo de uva. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
9. Pavisic Acalinovic, Liliana María (1997). Determinación de un concentrado de ciruela (Prunas domestica) utilizando geometría de cono y placa. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
10. Salazar López, Jacqueline (1986). Determinación de las propiedades reológicas de concentrado de manzana, su dependencia de la temperatura y la concentración. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
11. Silva Sánchez, Claudia Andrea (1996). Caracterización reológica de manjar blanco mediante la técnica de retroextrusión. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.
12. SteffeJ.F., Osorio F.A. (1987) “Backestrussion of non-newtonian fluids”. Food technology 41(3):72-77.
13. Vargas M. (1997). Retroextrusión y propiedades de un derivado lácteo. Memoria para optar al título de Ingeniero en Alimentos, Facultad de Química y Farmacia, Universidad de Chile, Stgo, Chile.

APPENDIX
APÉNDICES

1. Conversión factors / Factores de conversión

1. Density /densidad

1 g cm^{-3} = 1000 kg m^{-3} = 62.428 lbm pie^{-3} = 0.0361 lbm $pulg^{-3}$
1 lbm pie^{-3} = 16.0185 kg m^{-3}

2. Mass and strength / Masa y fuerza

1 lbm = 16 oz = 0.45359 kg = 453.593 g
1 kg = 1000 g = 0.001 ton metric = 2.20462 lbm = 35.274 oz
1 N = 1 kg m s^{-2} = 10^5 dyna = 10^5 g cm s^{-2} = 0.22481 lbf
1 lbf = 4.448 N = 32.174 lbm pie s^{-2}

3. Length / longitud

1 m = 1000 mm = 10^6 μm = 3.2808 pie = 39.37 pulg = 1.0936 yarda
1 pulg = 2.54 cm = 25.40 mm = 0.0254 m = 0.0833 pie = 0.02778 yarda

4. Power, torque and energy / Potencia, torque y energía

1 Btu = 1055 J = 1.055 kJ = 252.16 cal
1 hp = 550 pie lbf s^{-1} = 745.70 W = 0.7457 kW = 0.7068 Btu s^{-1}
1 W = 1 J s^{-1} = 0.23901 cal s^{-1} = 0.414 Btu h^{-1} = 1.341 (10^{-3}) hp
1 Btu hr^{-1} = 0.2931 W = 0.2931 J s^{-1}
1 Nm = 1 kg m^2 s^{-2} = 10^7 dyna cm = 0.7376 pie lbf = 9.486 (10^{-4}) Btu
1 pie lbf = 1.35582 Nm = 1.35582 J = 1.2851 (10^{-3}) Btu

5. Pressure and effort / Presión y esfuerzo

1 bar = 10^5 Pa = 14.5038 lbf $pulg^{-2}$ = 0.987 atm = 33.48 pie H_2O a 4 °C
1 Pa = 1 Nm^{-2} = 10 dyna cm^{-2} = 9.8692 (10^{-6}) atm = 7.5 (10^{-3}) torr
1 lbf $pulg^{-2}$ = 6894.8 Pa = 6.804(10^{-2}) atm = 6.895 kPa
1 lbf $pulg^{-2}$ = 2.309 pie H_2O = 2.0360 pulg Hg
1 dyna cm^{-2} = 0.10 Pa = 10^{-6} bar = 0.987 (10^{-6}) atm
1 atm = 101.325 kPa = 14.696 psi = 1.013 bar = 29.921 pulg Hg @ 0°C
1 atm = 760 mm Hg @ 0 °C = 33.90 pie H_2O a 4 °C

6. Temperature / temperatura

$T_{Kelvin} = T_{Celsius} + 273.15$
$T_{Kelvin} = (T_{Farenheit} + 459.67)/1.8$
$T_{Farenheit} = 1.8\ T_{Celsius} + 32$
$T_{Celsius} = (T_{Farenheit} - 32)/1.8$

7. Viscosity / viscosidad

1P = 1 dyna s cm^{-2} = 0.1 Pa s = 100 cP = 100 m Pa s
1 Pa s = 1000 cP = 10 P = 1 kg m^{-1} s^{-1} = 1 N s m^{-2} = 0.67197 lbm pie^{-1} s^{-1}
1 cP = 1 mPa s = 0.001 Pa s = 0.01 P
1 lbm pie^{-1} s^{-1} = 1.4882 kg m^{-1} s^{-1} = 1488.2 cP

8. Cinematic viscosity / viscosidad cinemática

1 cSt = 0.000001 m2 s^{-1} = 1 mm^2 s^{-1} = 5.58001 $pulg^2$ hr^{-1} = 0.00155 $pulg^2$ s^{-1}
1 St = 100 cSt = 0.0001 m^2 s^{-1}
1 m^2 s^{-1} = 10^{-5} cSt = 10.7639 pie^2 s^{-1}

9. Volume / volumen

1 m^3 = 10^6 cm^3 = 10^3 L (litros) = 264.17 gal (US) = 35.3145 pie^3
1 pie^3 = 0.028317 m^3 = 7.4805 gal (US) = 28.317 L = 6.2288 gal (UK)
1 gal (US) = 128 oz (fluida) = 3.7854 L = 0.8327 gal (UK) = 0.003785 m^3
1 m^3 s^{-1} = 15,850.2 US gal min^{-1} = 264.17 US gal s^{-1}
1 US gal min^{-1} = 6.30902 (10^{-5}) m^3 s^{-1} = 3.7854 L min^{-1}
1 lbm hr^{-1} = 0.453592 kg hr^{-1} = 1.25998 (10^{-4}) kg s^{-1}

2. Greek alphabet / Alfabeto Griego

Α - α	Alpha	Alpha	**Ν - ν**	Nu	Nu
Β - β	Beta	Beta	**Ξ - ξ**	Xi	Xi
Γ - γ	Gamma	Gamma	**Ο - ο**	Omicron	Omicron
Δ - δ	Delta	Delta	**Π - π**	Pi	Pi
Ε - ε	Épsilon	Épsilon	**Ρ - ρ**	Rho	Rho
Ζ - ζ	Zeta	Zeta	**Σ - σ**	Sigma	Sigma
Η - η	Eta	Eta	**Τ - τ**	Tau	Tau
Θ - θ	Theta	Theta	**Υ - υ**	Upsilon	Ipsilon
Ι - ι	Iota	Iota	**Φ - φ**	Phi	Fi
Κ - κ	Kappa	Kappa	**Χ - χ**	Chi	Ji
Λ - λ	Lambda	Lambda	**Ψ - ψ**	Psi	Psi
Μ - μ	Mu	Mu	**Ω - ω**	Omega	Omega