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Effect of different loading density and pretreatment on drying characteristics of mint leaves under cabinet tray dryer

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Abstract

The suitable drying techniques are the most important aspect of leafy vegetable preservation. The use of cabinet tray dryer helps to reduce the losses and improves the quality of product. The experiments were conducted to develop dehydrated mint leaves so as to enhance the availability of mint leaves during off season. In the present study, fresh mint leaves were categorized in to untreated leaves (control) and blanched treated in boiled water for 1 min. the leaves were dried at 1.5,3.0,4.5 kg/m^2 loading density with three levels of temperature (45^{0}C,55^{0}C,65^{0}C) under cabinet tray dryer. Untreated mint leaves were also dried as control samples. Experiments were also conducted to study the effect of loading density, treatment and temperature on drying characteristics of mint leaves. The product quality was found to be most acceptable of untreated dried mint leaves dried at 55^{0}C using 3.0 kg/m^2 loading density.

Drying is the major processing technique practiced for the preservation of vegetables which can be accomplished with little capital and produces shelf stable food products. Drying is a process of heat and mass transfer simultaneously where the heat energy is applied to the product to increase the temperature of the product and to vaporize the moisture present in the product through provision of latent heat of vaporization. The lower water content slows the rate of enzymatic action and overall deterioration rate, and makes products less susceptible to decay. Dehydration also brings about substantial reduction in weight and volume; resulting into less expenses towards packaging, storage and transportation costs and also enables storability of the product under ambient temperature (Mazumdar, 1995).

Drying process should be undertaken in closed equipment to improve the quality of the product (Ertekin and Yaldiz, 2004). Industrial dryers should be used to achieve consistent quality of the product. Industrial dryers are rapid and provide uniform and hygienic dried product (Doymaz and Pala, 2002). A number of studies for drying of fruits and vegetables have been reported by various authors (Maskan *et al.,* 2002; Togrul and Pehlivan, 2002; Erenturk *et al.,* 2004; Doymaz, 2006; Akpinar, 2006; Kadam *et al*., 2008, 2009a, 2009b, 2010). The green leafy vegetables can be successfully preserved by dehydration technology, since the dehydration industry need not depend on imports for raw materials. The green leafy vegetable powders certainly have the potential to enter processed food industry and can compete in the dehydrated foods market. The degradation of naturally occurring colour pigments in the food during thermal processing is a major problem. Although with the advent of high temperature short time processing methods, it has become possible to reduce the destruction of pigment in processing steps (Tan and Francis, 1962). Being a flavouring spice, flavour retention is as important as the colour retention in coriander. Hence, low temperature drying is much suitable to achieve the quality dehydrated product. Blanching of vegetables is carried out before drying to inactivate natural enzymes in order to improve colour, texture and ultimately the overall acceptability of the product(Ahmed *et al.,* 2001). For green vegetables, pretreatment prior to drying can aid the chlorophyll retention during drying operation. Several studies have been carried out to investigate the effect of pretreatment and hot air temperature on quality of processed vegetables (Kaur *et al*., 2006).

The degree of greenness is important in determining the final quality of thermally processed green vegetables which gets their colour from chlorophyll pigments. Chlorophyll *a* and chlorophyll *b* are typically found in higher plants commonly utilized for food and they occur in an approximate ratio of 3:1 (Francis, 1985). Chlorophyll *a* appears blue - green and thermally less stable than chlorophyll *b* which appears yellow – green (Tan and Francis, 1962). The degradation of naturally occurring colour pigments in the food during thermal processing is a major problem. In all green vegetables the change in colour from bright green to dull olive - green or olive - green colour is due to the conversion of chlorophyll to their respective pheophytins and further breakdown of products such as pheophorbides and chlorines, which is undesirable to the consumer (Schwartz *et al*., 1983).

Mint leaves (*mentha spicata L.)* are a common name for members of the Labiatae (Laminaceae Family). It is a large family of annual or perennial herbs and widely grown all over the world to reap its special herbal characteristics. Mint leaves are very popular in Mediterranean regions and represent a dominant part of the vegetation. Mint leaves are known for refreshing, antiseptic, anti-asthmatic, simulative, diaphoretic, stomachic and antispasmodic features. Mint leaves are used in both fresh and dried form in different cuisines.Mint plants typically contain 75-85% (wb) moisture content at harvest and are normally harvested when in full bloom (Diaz- Maroto *et al,* 2003; Doymaz, 2006; Rohloff *et al,* 2005). Various authors (Park *et al.,* 2002; The Columbia electronic Encyclopedia, 2005; Thompson, 2003)have indicated the use of mint leaves in a variety of dishes such as vegetable curries, chutney, fruit salads, vegetable salads, salad dressing, soups, desserts, juices, sherbets etc. Mint is also very popular in India and mainly cultivated in southern parts of Himalayan range including Uttar Pradesh, Punjab, Himachal Pradesh, Haryana and Bihar. Comparative studies of different loading densityon drying characteristics of high moisture vegetable like mint leaves are very few. Considering the advantages and disadvantages of loading density with tray dryer, its performance evaluation for drying the mint leaves should be studied.

Materials and methods

The study was undertaken to evaluate the drying characteristics of mint leaves in Food and Process Enigineering, of the Department of Agricultural Engineering and Food Technology, S.V.P. University of Agriculture and technology, Meerut. The mint *(Mentha spicata*) was procured from the nearest farmer's field, Meerut for the purpose of experiment, during crop season of 2013-2014. Geographically, Meerut is located at 29^0 01 North latitude, 77^0 45 East longitude and at an altitude of 219.75 meter above the mean sea level.

Fresh Mint leaves were sorted, trimmed and washed thoroughly in fresh water to remove roots, stem and soft stem from the rest parts. Care was taken to avoid bruised and discoloured leaves. It was observed that loading density (weight of sample per unit area) was mostly preferred for drying of leafy vegetables. Hence, it was decided to use sample with a variable loading density of 1.5, 3.0 and 4.5 kg/m^2. Blanching of leaves (1:5 ratio, leaves: water) as pretreatment for 1 min was performed. Untreated mint leaves were dried as fresh leaves. Pretreated and control samples were exposed to three levels of loading density viz. 1.5, 3.0 and 4.5 kg/m^2. The leaves were weighed and loaded in aluminium trays and then kept for drying in the cabinet tray dryer at 45, 55 and 65^0C. The time interval for drying of mint leaves was decided on the basis of literatures available, which was fixed to thirty minutes. It was found that low temperature drying is preferred to retain the green colour and flavour of mint leaves to an acceptable level.

Initial moisture content (IMC) of sample was determined by Ranganna (1986). Moisture Ratio (MR) is calculated as follows.

$$MR = \frac{M - Me}{Mo - Me} \qquad \dots 1$$

Where,

M= Moisture content, % (d. b.) at time t (min.) during drying.

M_o= Moisture content, % (d. b.) at the initiation of drying i.e. at zero time.

M_e= Equilibrium moisture content, % (d. b.).

In thin layer drying process, the drying action has been represented as follows:

$$\frac{dM}{dt} = -K\,(M - M_e) \qquad \dots 2$$

From the above equation (Brooker *et al.,* 1974), it is clear that for a positive value of constant K, $\frac{dM}{dt}$ would be negative when $M>M_e$ (i.e. the material will lose moisture with respect to time), for a negative value of constant K, $\frac{dM}{dt}$ would be positive when $M<M_e$ (i.e. the material will gain moisture with respect to time). During drying process, there is a loss of moisture with time; therefore, the drying rate indicates the rate of loss of moisture of the sample.

Results and discussion

The present investigation was carried out to evaluate drying behaviour under cabinet tray drying (mechanical drying). In the experiment, mint leaves were categorized into untreated (control) leaves and blanched treated in boiled water for one minute with three levels of loading density and allowed to dry at different temperatures (45ºC, 55ºC, 65ºC) at an interval of 30 min and observations were taken accordingly. The average values of moisture content were calculated as 83.4% and 84.3% (w.b.) for untreated and treated leaves respectively. The samples were dried from initial moisture content of 502.409 to 536.943 % (db) to the final moisture content of 3.73 to 4.681 % (db). The loss in weight was converted to corresponding moisture loss for calculating moisture content (db). The calculated moisture content (db) was used as basic data for further analysis. The effects of variable were interpreted using F-ratio value. The effect of variable on quality was considered significant if the calculated F value was obtained more than that of F-tabulated. Moisture content, drying rate, moisture ratio and drying time were evaluated during the experiment. ANOVA for various experiments was done by using MINITAB software. The moisture content, moisture ratio and drying rate at different time intervals at different temperatures were compared for treated and untreated samples under different loading densities. Results of the present investigation are discussed below:

Effect on moisture content: The data for moisture content is given in Table 3&4. The initial moisture content prior to drying was observed in the range 502.409 - 536.943 % (db). It was found that the drying time of the untreated leaves samples were less than the blanched leaves sample. For example, The untreated mint leaves took 450 minutes where blanched treated leaves took 510 minutes to dehydrate completely at 45ºC under 1.5 kg/m² loading density with final moisture content of 3.614 % and 3.821 %, respectively. It was also found that the final moisture content of untreated mint leaves was 3.614 %, 3.493 % and 3.373 % at 45ºC, 55ºC and 65ºC respectively under loading density 1.5 kg/m^2 (Table 1). It increased with loading density and became 4.216 %, 3.915 %, 3.614 % and 4.417 % 4.216 %, 3.775 % at loading density 3.0 kg/m² and 1.5 kg/m² at 45ºC, 55ºC, 65ºC respectively. The final moisture content of blanched mint leaves was 3.821 %, 3.566 % and 3.439 % at 45ºC, 55ºC and 65ºC respectively under 1.5 kg/m² loading density. It increased with loading density and became 4.267 %, 4.140 %, 3.821 % and 4.680 %, 4.468 %, 4.255 % at loading density 3.0 kg/m² and 4.5 kg/m² at 45ºC, 55ºC, 65ºC respectively.

It was observed that drying time increases with loading density. As expected the drying time varied with drying temperature and loading density. The total moisture loss increased with increase in drying temperature. It was also observed the final moisture content of treated as well as untreated leaves increases with the increase in loading density. The drying rate of the samples dried at 65ºC was found to be higher than those of other drying temperatures, the reason behind it may be attributed to removal of free moisture at initial stage of drying. The mint did not have any constant drying rate period and the entire drying took place in falling rate period irrespective of drying temperature. Results of study revealed that the removal of moisture from the samples decreased gradually with increase in drying time to attain final moisture content. There is a non-linear decrease of moisture content with drying time. Initially the moisture content decreases rapidly with time and there after it becomes slower and slower and at last a stage comes when it becomes saturated. In the fallen rate period, the material surface was no longer saturated with water and drying was controlled from diffusion of moisture from the interior of the material to the surface

Effect on Moisture ratio: The value of moisture content (% d.b.) and moisture ratio observed in experiment at different temperatures and loading densities are shown in Table (5 & 6) which clearly shows moisture ratio initially decreased very rapidly and in later stage moisture ratio decreased at slower rate. In general, results showed that moisture ratio decreased continuously as drying progressed with the diffusion process slowing down. The moisture ratio values at zero time of drying was one in all cases but in successive drying it decreased non-linearly. Therefore, moisture ratio versus drying time could better describe the drying phenomena than curves of moisture content versus drying time because the former had same initial value of moisture ratio (M.R.=1) but latter have different initial moisture content.

Effect on average drying rate: The average drying rate represents the rate of change of moisture content (% db) over a particular time interval. It can be expressed in % db/min as shown in Table (7 & 8). The drying rate at higher temperature is larger as compare to lower temperature and decrease with drying time. For example the drying rate of blanched treated sample at 65ºC under 1.5 kg/m^2 loading density was 7.091 (% db/min) and reduced to 0.033 (% db/min) at last. Initially the average drying rate decreases rapidly with temperature and as the time progresses the rate becomes slower and slower thereafter. The rate of drying was affected by temperature, loading density and treatment. The decrease in drying rate with the period of drying was non-linear. The internal mass transfer was there by molecular diffusion or vapours diffusion or by capillary forces in the interior region of the product and the water was evaporated as it reached the surface. The most probable mechanism within all mechanisms governing moisture transfer was the liquid diffusion.

Effect on overall drying rate: It was observed that the overall drying rate decreased with increase in loading density and increased with increase in temperature in each treatment. It is also seen the overall drying rate of blanched treated is slightly lower than untreated leaves for almost all samples. Overall drying rate varied from 0.887 to 2.376% (db/min.) for the total range of variables of the study. Table 1 showed over all drying rate at different temperatures, treatments and loading density. The ANOVA was carried out of analyzing effect of temperature, loading density and treatment on overall drying rate and it was found that the effect of all temperatures and loading densities was significant at 5% level of significant as F_c was obtained more than $F_{tab.}$ and the effect of treatment was insignificant at 5% level of significant as F_c (0.27) is less than F_{tab} (4.7472). The ANOVA is presented in Table 2.

Conclusion

Initially the moisture content decreases rapidly with time and there after it becomes slower and slower. In the fallen rate period, the material surface was no longer saturated with water and drying was controlled from diffusion of moisture from the interior of the material to the surface. Initially the average drying rate decreases rapidly with temperature and as the time progresses the rate becomes slower and slower thereafter. It is also seen that the overall drying rate decreased with loading density in each treatment. The overall drying rate of blanched leaves sample was slightly lower for untreated leaves sample for almost all samples. It was observed that total moisture loss increased with increase in drying temperature and decreased with decrease in drying temperature. The drying rate of the samples dried at 65ºC was found to be higher than those of other drying temperatures, the reason behind it may be attributed for removal of free moisture at initial stage of drying. Moisture ratio initially decreased very rapidly and in later stage decreased at slower rate continuously as drying progressed with the diffusion process slowing down.

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Table 1: Overall drying characteristics of mint at different temperatures and loading density

Temperature	Loading density	Treatment	Initial M.C. (% db)	Final M.C (% db)	Drying time (min)	Overall drying rate (% db/min)
45ºC	0.5 Kg/m²	UT	502.409	3.614	450	1.108
		BT	536.943	3.821	510	1.045
	1.0 Kg/m²	UT	502.409	4.216	510	0.977
		BT	536.943	4.267	570	0.935
	1.5 Kg/m²	UT	502.409	4.417	540	0.922
		BT	536.943	4.680	600	0.887
55ºC	0.5 Kg/m²	UT	502.409	3.493	330	1.512
		BT	536.943	3.566	360	1.482
	1.0 Kg/m²	UT	502.409	3.915	390	1.278
		BT	536.943	4.140	420	1.269
	1.5 Kg/m²	UT	502.409	4.216	420	1.186
		BT	536.943	4.468	480	1.109
65ºC	0.5 Kg/m²	UT	502.409	3.373	210	2.376
		BT	536.943	3.439	240	2.223
	1.0 Kg/m²	UT	502.409	3.614	300	1.663
		BT	536.943	3.821	330	1.615
	1.5 Kg/m²	UT	502.409	3.775	360	1.385
		BT	536.943	4.255	390	1.365

Table 2 ANOVA for effect of drying condition on drying rate

Source of Variation	DF	Sum Of Squares(SS)	Mean Sum Of Squares(MSS)	F- Calculated Value	F-Tab*Value
Temperature	2	0.97	0.48	9.59	3.8853
Loading Density	2	3.77	1.89	37.33	3.8853
Treatment	1	0.01	0.01	0.27	4.7472
Error	12	0.61	0.05		

* = Significant at 5% level of significance

Table 3: Effect of loading density and temperature on moisture content (%, db) of untreated dried mint under cabinet tray dryer

Time (min)	Loading density								
	1.5 kg/m^2			3.0 kg/m^2			4.5 kg/m^2		
	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C
0	502.40	502.40	502.40	502.40	502.40	502.40	502.40	502.40	502.40
30	415.66	377.10	350.60	424.09	424.09	421.08	430.12	442.16	422.49
60	351.80	273.49	202.40	354.81	351.80	350.60	373.89	389.95	351.80
90	290.36	175.30	86.74	291.56	291.56	287.95	325.70	346.18	291.16
120	237.34	90.96	12.84	238.55	237.34	227.10	281.52	306.02	231.32
150	187.95	41.56	8.43	189.15	189.15	167.47	242.16	267.46	172.28
180	139.75	26.50	4.81	143.37	150.00	110.84	207.22	229.31	115.86
210	106.02	19.27	3.37	104.81	113.85	56.02	175.90	192.36	68.67
240	81.92	13.85		71.68	80.12	15.06	144.97	155.82	25.50
270	59.03	9.63		46.98	49.39	5.42	120.88	120.48	8.63
300	37.34	6.02		27.10	20.78	3.61	100.00	87.14	6.42
330	20.48	3.49		17.46	8.73		82.73	56.62	4.81
360	14.45			10.84	4.81		67.06	28.51	3.77
390	9.63			8.43	3.91		51.80	8.43	
420	6.02			6.32			38.55	4.21	
450	3.61			5.12			26.10		
480				4.51			14.05		
510				4.21			5.220		
540							4.417		

Table 4: Effect of loading density and temperature on moisture content (%, db) of blanched dried mint under cabinet tray dryer

Time (min)	Loading density								
	1.5 kg/m^2			3.0 kg/m^2			4.5 kg/m^2		
	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C
0	536.942	536.942	536.9427	536.942	536.942	536.9427	536.942	536.942	536.943
30	421.019	355.414	324.203	441.401	455.414	444.586	453.191	469.361	446.809
60	342.038	214.012	159.872	377.707	387.261	364.968	391.489	402.978	359.574
90	274.522	96.815	51.592	317.197	323.566	289.808	346.808	340.000	274.468
120	209.551	33.757	15.923	259.872	260.509	215.286	305.957	288.085	191.064
150	154.140	21.019	9.554	205.732	198.726	142.038	265.957	239.574	125.532
180	112.738	14.649	5.732	159.872	137.579	72.929	229.361	192.766	74.468
210	77.707	10.828	4.458	119.745	81.847	38.216	197.021	151.063	40.426
240	50.318	8.280	3.439	89.808	39.490	19.745	166.383	117.872	21.277
270	37.579	6.369		62.420	17.834	8.917	136.170	88.510	8.511
300	26.751	5.095		49.681	10.828	5.095	109.361	60.000	6.809
330	19.745	4.076		38.853	8.280	3.821	83.829	32.340	5.532
360	14.649	3.566		29.936	6.369		60.851	9.787	4.681
390	10.828			22.929	5.095		39.574	7.659	4.255
420	8.280			16.560	4.140		19.148	6.382	
450	6.369			11.464			12.340	5.106	
480	4.968			8.280			9.787	4.468	
510	3.821			5.732			7.659		
540				4.458			6.382		
570				4.267			5.319		
600							4.680		

Table 5: Effect of loading density and temperature on moisture ratio (%, db) of untreated dried mint under cabinet tray dryer

Time (min)	Loading density								
	1.5 kg/m^2			3.0 kg/m^2			4.5 kg/m^2		
	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
30	0.826	0.748	0.695	0.845	0.842	0.837	0.854	0.879	0.839
60	0.698	0.541	0.398	0.703	0.697	0.696	0.741	0.774	0.697
90	0.575	0.344	0.167	0.576	0.577	0.570	0.645	0.686	0.576
120	0.469	0.175	0.014	0.470	0.468	0.448	0.556	0.605	0.456
150	0.370	0.076	0.010	0.371	0.371	0.329	0.477	0.528	0.337
180	0.273	0.046	0.002	0.279	0.293	0.215	0.407	0.451	0.224
210	0.205	0.031	000	0.201	0.220	0.105	0.344	0.377	0.130
240	0.157	0.020		0.135	0.152	0.023	0.282	0.304	0.043
270	0.111	0.012		0.085	0.091	0.004	0.233	0.233	0.009
300	0.068	0.005		0.045	0.033	0.000	0.191	0.166	0.005
330	0.034	000		0.026	0.009		0.157	0.105	0.002
360	0.022			0.013	0.001		0.125	0.048	000
390	0.012			0.008	000		0.095	0.008	
420	0.005			0.004			0.068	000	
450	0.000			0.001			0.043		
480				0.000			0.019		
510				000			0.001		
540							000		

Table 6: Effect of loading density and temperature on moisture ratio (%, db) of blanched dried mint under cabinet tray dryer

Time (min)	Loading density								
	1.5 kg/m2			3.0 kg/m2			4.5 kg/m2		
	45⁰C	55⁰C	65⁰C	45⁰C	55⁰C	65⁰C	45⁰C	55⁰C	65⁰C
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
30	0.782	0.659	0.601	0.820	0.846	0.826	0.842	0.873	0.831
60	0.634	0.394	0.293	0.701	0.719	0.677	0.726	0.748	0.667
90	0.507	0.174	0.090	0.587	0.599	0.536	0.642	0.630	0.507
120	0.385	0.056	0.023	0.479	0.481	0.396	0.566	0.532	0.351
150	0.281	0.032	0.011	0.378	0.365	0.259	0.490	0.441	0.228
180	0.204	0.020	0.004	0.292	0.250	0.129	0.422	0.353	0.132
210	0.138	0.013	0.001	0.216	0.145	0.064	0.361	0.275	0.068
240	0.087	0.008	000	0.160	0.066	0.029	0.303	0.212	0.032
270	0.063	0.005		0.109	0.025	0.009	0.247	0.157	0.008
300	0.043	0.002		0.085	0.0125	0.002	0.196	0.104	0.005
330	0.029	0.000		0.064	0.007	000	0.148	0.052	0.002
360	0.020	000		0.048	0.004		0.105	0.009	0.001
390	0.013			0.035	0.001		0.065	0.005	0.000
420	0.008			0.023	000		0.027	0.003	
450	0.004			0.013			0.014	0.001	
480	0.002			0.007			0.009	000	
510	000			0.002			0.005		
540				0.000			0.003		
570				000			0.001		
600							000		

Table 7: Effect of loading density and temperature on average drying rate (% db/min) of untreated dried mint under cabinet tray dryer

Time (min)	Loading density								
	1.5 kg/m^2			3.0 kg/m^2			4.5 kg/m^2		
	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C
0	0	0	0	0	0	0	0	0	0
30	2.891	4.176	5.060	2.569	2.610	2.711	2.409	2.007	2.664
60	2.129	3.453	4.939	2.349	2.409	2.349	1.874	1.621	2.356
90	2.048	3.273	3.855	2.108	2.008	2.088	1.606	1.459	2.021
120	1.767	2.811	2.530	1.767	1.807	2.028	1.472	1.338	1.994
150	1.647	1.646	0.147	1.646	1.606	1.988	1.311	1.285	1.967
180	1.606	0.502	0.120	1.526	1.305	1.888	1.164	1.271	1.880
210	1.124	0.240	0.048	1.285	1.204	1.827	1.044	1.231	1.572
240	0.803	0.180		1.104	1.124	1.365	1.030	1.218	1.439
270	0.763	0.140		0.823	1.024	0.321	0.803	1.178	0.562
300	0.723	0.120		0.662	0.953	0.060	0.696	1.111	0.073
330	0.562	0.084		0.321	0.401		0.575	1.017	0.053
360	0.201			0.220	0.130		0.522	0.937	0.034
390	0.161			0.080	0.030		0.508	0.669	
420	0.120			0.070			0.441	0.140	
450	0.080			0.040			0.414		
480				0.020			0.401		
510				0.010			0.294		
540							0.026		

Table 8: Effect of loading density and temperature on average drying rate (% db/min) of blanched dried mint under cabinet tray dryer

Time (min)	Loading density								
	1.5 kg/m^2			3.0 kg/m^2			4.5 kg/m^2		
	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C	45^{0}C	55^{0}C	65^{0}C
0	0	0	0	0	0	0	0	0	0
30	3.864	6.050	7.091	2.684	2.717	3.078	2.791	2.852	3.004
60	2.632	4.713	5.477	2.123	2.271	2.653	2.056	2.212	2.908
90	2.250	3.906	3.609	2.016	2.123	2.505	1.489	2.099	2.837
120	2.165	2.101	1.188	1.910	2.101	2.484	1.361	1.730	2.780
150	1.847	0.424	0.212	1.804	2.059	2.441	1.333	1.617	2.184
180	1.380	0.212	0.127	1.528	2.038	2.303	1.219	1.560	1.702
210	1.167	0.127	0.042	1.337	1.857	1.157	1.078	1.390	1.135
240	0.912	0.084	0.037	0.997	1.411	0.615	1.021	1.106	0.638
270	0.424	0.063		0.912	0.721	0.360	1.007	0.978	0.426
300	0.360	0.042		0.424	0.233	0.127	0.893	0.950	0.057
330	0.233	0.033		0.360	0.084	0.042	0.851	0.921	0.043
360	0.169	0.016		0.297	0.063		0.765	0.751	0.028
390	0.127			0.233	0.042		0.709	0.070	0.014
420	0.084			0.212	0.031		0.680	0.042	
450	0.063			0.169			0.226	0.042	
480	0.046			0.106			0.085	0.021	
510	0.038			0.084			0.070		
540				0.042			0.042		
570				0.006			0.035		
600							0.021		