Evaluation of Quality and Shelf-life of Seasoning Chicken Fillets using Pure Egyptian Honey

Takwa H. Ismail

Dept. of Food Hygiene, Animal Health research Institute, Ismailia, Egypt

Abstract

The effects of pure Egyptian honey on the sensory, bacteriological and chemical quality of seasoning chicken fillets were studied. Therefor 60 fresh chicken fillets samples were used in this study. Seasoning chicken fillets (3 groups) were treated with 0% (control), 5% and 15% pure honey respectively then stored at 3°C+ 1 wheras sensory, bacteriological and chemical evaluation were conducted during at intervals of 0, 2, 4, 6, 8 and 10 days. Treating of chicken fillets with 5% and 15% honey were improved the general appearance, flavour, consistency and flesh colour of the samples up to 10 days. Total psychrophiles counts reached the unacceptable count (6×10^6) at 8th day in 0% control samples while reached ($9x\ 10^5$ & $4x\ 10^5$) at 10th day in each treated samples with 5% and 15% honey respectively. Lower lipolytic psychrophilic counts were obtained in treated samples which reflect the inhibitory effect of honey. Honey showed an inhibitory effect on *Aeromonas hydrophila*, *Bacillus cereus*, *E. coil*, *Pseudoomonas spp.*, *Proteus spp.* and *Staphylococcus aureus*. Chicken fillets treated with 5% and 15% honey showed lower pH values and moisture content all over storage period in compared to control. Honey delayed the rancidity represented by Thiobarbituric Acid values which their values were acceptable to the end of the storage period. Honey at levels of 5% and 15% may be used as a natural alternative to chemical preservatives in chicken fillets.

Introduction

Honey is a sweet and flavorful product which has been consumed as a high nutritive value food. It is essentially composed of a complex mixture of carbohydrates (of which fructose and glucose account for nearly 85–95%) and other minor substances, such as organic acids, amino acids, proteins, minerals, vitamins, and lipids (White, 1975). Honey has been used since ancient time as apart of traditional medicine, attractive ingredients for healthy foods, antibacterial, antioxidant, antitumor and anti-inflammatory (Viuda-Martos *et al.*, 2008).

Food processors are known to use honey in many different food products for its sweetness, functional advantages as viscosity, flavour hygroscopic, miscibility and spread ability as well as its natural appeal (Labell, 1988). The mixing of honey with brine for seasoning the meat fillets has a significant improvement of flavours and cooking yield of the fillets (Dawson, 1998). Honey has been evaluated for its antimicrobial effect against spoilage and pathogenic organisms.

Several studies confirmed the efficacy of honey as food additives in im the shelf-life and nutritional qualities of food products (Anatony *et al.* Krusha *et al.*, 2007; Belewu & Morakinyo, 2009 and Gomes *et al.*, 20 development of off-flavors in ready to eat chicken products is a c problem and results in a product of less desirable to consumers. Colou primary quality parameter that changed when the ready to eat chicke become unfit for consuming. Psychrotrophic lipolyic bacteria can be p extracellular lipase enzyme during their growth in meat products whi cause fat deterioration, quality changes, decreasing the shelf-life and pr organoleptic disorders which let the products to be unattractive to co (Papan *et al.*, 1990).

Fung (2007) used honey for control the pathogenic bacteria in turkey slices, their results recorded improving in the safety of meat from pathog to 14 days post-storage at chilling temperature. Another studies done b & Nicki, (2002) and Antony *et al.*, (2006) confirmed that addition of 5% a honey to meat was effective in preventing rancidity due to its antioxidan Therefore, this study was planned to evaluate the effect of honey as a preservative on the shelf-life of seasoning chicken fillets stored under chil

Material and Methods

Samples Collection and Preparation
A total of 60 fresh chicken fillets were purchased from local markets on of preparation. The chicken samples were double-bagged and shipped cooled insulated containers with sufficient frozen jell packs to n temperature below 5°C during transport. Chicken fillets were marinat regualer seasoning ingredients then divided into three equal group. Fillet were treated with 0% (control), 5% and 15% pure honey respectivel sample was placed in a chiller at 3°C+ 1. Sensory, bacteriological and c evaluation were conducted during chilling at intervals of 0, 2, 4, 6, 8 days.

1- Sensory evaluation :
The procedure recommended by Marry Morr (1970) was used for evaluation. Panelists were asked to sign a consent form. Acceptance was used to determine how much each sample was liked based on a hedonic scale for a set appearance, flavour, consistency and colou 10=like excellent and 5=dislike poor.

2- Bacteriological evaluation (APHA, 1992):
Ten grams of chicken fillet were transferred under aseptic condition to blender jar containing 90 ml of 1% sterile peptone water for 2 min. stomacher (*400 lab Blender*) to provide dilution of 10^{-1}. One ml homogen

transferred into separate tubes, each containing 9 ml peptone water 1%, from which 10 fold serial dilution up to 10^{-6} were prepared.

2.1. Determination of Total psychrophiles count (AOAC, 1990): On each duplicate standard plate count agar, 0.1 ml from each previously prepared dilution was plated by using surface plate technique. The inoculated plates were incubated at 7°c for 5 to 7 days and the total psychrophiles count was expressed as CFU/g.

2.2. Determination of Total lipolytic psychrophiles count (APHA, 1992): The technique was determined by spreading 0.1 ml of each dilution of prepared food samples on tributyrin agar, the inoculated plates was incubated at 7°c for 10 days

2.3. Detection of Aeromonas (Shotts & Rimler, 1973)

Loopfuls from inoculated tubes were streaked on dry duplicated R-S (Rimler & Shotts) plates and incubated at 25°c for 3 days (rounded 2-3 mm yellow colonies) were considered to be of Aeromonas

2.4. detection of Pseudomonas (ICMSF, 1978)

The same technique of the streaked method was applied using Pseudomonas F. agar media + 1% Bactoglycerol. Inoculated plates were incubated at 25°c for 24-48 hours. Suspected colonies were (blue green pigmentation).

3- Chemical evaluation:

Determination of pH content: Fillets samples were subjected to evaluation for pH value according to technique recommended by Dodge and Stadelmen, (1960).

Determination of Moisture content: Moisture content for fillets samples were measured according to Official Method NO. 934.06: recommended by (AOAC, 1990). The moisture content is expressed as percentage by mass (grams per 100 grams).

Determination of TBA Values: TBARS value was determined by the technique recommended by Vyncke (1970). The absorbance was measured against the blank at 538 nm. TBA value was expressed as mg malonaldehyde /kg fillet samples.

Result and Discussion

Sensory Quality:

The result obtained in table (1) revealed that sensory scores (general appearance, flavour, consistency and flesh colour) were slightly decline and still with a good sensory characteristic until six day in control samples while in treated samples (5% and 15% honey), the organoleptic scores begin change after 10 day, the flesh colour score of treated samples (15% honey) become slightly dark with storage time due to a natural protein- sugar reaction called the Millard reaction produces a brown pigment, flavors and antioxidants, these results were agree with (Antony *at al.*, 2006) which found little difference in the sensory attributes among treated turkey slices with 5% & 15% of honey at 4°C where ranked highest in juiciness and tenderness.

These results agree with sensory scores of baked chicken marinated honey which had significantly darker exterior (lower light value) thar marinated with 0% or 20% honey (Hashim *et al.*, 1999) and highly sc juiciness, flavor, tenderness, sweetness and colour of cheese sample with honey due to the strong hygroscopic ability of honey (Bel Morakinyo, 2009).

Microbiological quality

From the results given in a table (2), it is noticed that total psychrophi reached the unacceptable count (6×10^6) at 8th day in 0% control samp reached (9×10^5 & 4×10^5) at 10th day in each treated samples with 5% honey respectively, Antony *at al.*, (2006) found that little or no bacterial 10^2 cfu/g) after 11 week of storage packaged processed Turkey slice with 15% honey.The antimicrobial effects of honey is well confirmed (T *al.*, 2002), Pure honey showed bactericidal and fungicidal effect when different kinds of foods even the high acidic foods (Snow and Manl 2004 and Mundo *et al.*, 2004). Honey at different concentrations (5, 10 had an inhibitory effect on some food borne pathogens a *E coli, S. au lactus* and *Salmonella typhimurium* (Belewu & Morakinyo, 2009).

The antibacterial properties of honey against gram positive and gram bacteria were due to acidity, osmolarity, conversion of glucose to peroxide by glucose oxidase, drowing water from bacterial cells and de them (Selcuk and Nevin, 2002).

Egyptian Organization for Standardization and Quality control (EOS, 2(standard maximum limit of 10^5cfu/g for total aerobic count in chilling po with maximum 6 days of storage at 4°C. Based on this standard, contr did not comply with the Egyptian standards criteria when compared group (5% & 15% honey) which give significant improvement in its sh to 10 days of storage at 4°C..

The mean values of total lipolytic psychrophiles for 0%, 5% and 15' fillets groups were 7×10^5 (day 8) , 8×10^4 and 6×10^4 (day 10) respecti lower mean lipolytic counts obtained in treated samples reflect the effect of honey on the bacterial growth.The results obtained in table (3 that *Aeromonas hydrophila* not detected in all examined samples. Hon an inhibitory effect on *Bacillus cereus, E. coil*, pseudoomonas, *Proteus Staphylococcus aureus* from days 4, 6 to day 10 in concentration 5% respectively.

The inhibitory effect of honey against *Enterobacter spp.* , *B. c Monocytogenes, Lactococcus lactis*, pseudomonas *spp.*, *Proteus* Staphylococcus were reported by (Adebolu, 2005, Annas and Taghre Selcuk and Nevin, 2002, Belewu and Morakinyo,2009 and Abd El-/ 2007). Ranya, (2005) found that *Pseudomonas aeruginosa* couldn't be after 2 days at 4°C in sample of yoghurt contained honey.

Chemical quality:

The results obtained in table (4) revealed that there did not seem to be any specific trend in the pH values with storage time. pH of the 0%, 5% and 15% honey groups descended from 6.25, 5.39 and 5.65 respectively. The higher pH values for control group during storage period may be due to breakdown of protein and consequently the increase of ammonia and free amine group produced in meat (Cuzzoni and Gazzani, 1984). Meanwhile, descending of treated samples pH value due to characteristically quite acidic pH of honey between 3.2 and 4.5 which is low enough to be inhibitory to many pathogens (Krushna *et al.*, 2007 and Antony *et al.*, 2006).

The result obtained in table (4) revealed that the mean values of moisture content of the honey treated samples were lower than the control. The reduction of moisture content could be due to the effect of osmotic pressure and low water activity of the honey and its hygroscopic ability (Belewu and Morakinyo, 2009 and tuley, 1989). On other side, Antony *et al.*, (2006) recorded that moisture content of packaged Turkey slices was averaged over time of storage at 4°C was 71.46, 69.29 and 65.07 for control, 5% and 15% honey added samples respectively. Hashim *et al.*, (1999) recorded that means of moisture content of marinated seasoning chicken with 0% control, 20% and 30% honey was 70.77, 67.71 and 67.31 respectively. Antony *et al.*, (2000) recorded that moisture content of cooked turkey breast meat treated with honey after 48 h at 4°C was 73.9% .

The results abtained in table (4) revealed that the mean values of TBA reached 0.100 mg/100g in the control sample at 8th day, while it reached 0.057 and 0.054 mg/100 g in 5% and 15% honey treated samples at 10th day. The acceptable limit for TBA in meat do not exceed than 0.9 mg/kg according to EOS, (2005). It is evident that TBA increased gradually with the time of meat storage due to formation of maloneldehyde (Gray and Crakal, 1992). Malonaldahyde production in the food may be affected by the temperature, cooking time, food acidity, fat amount in the product, the degree of unsaturation of the fatty acids and the length of time spent in contact with molecular oxygen (Devore, 1988).

These finding were agree with Antony *et al.*, (2000 & 2006) which confirmed the relationship between TBA values and percentage of honey added, with 15% to turkey slices at 4°C in control of fat oxidation. In addition to Johnston *et al.*, (2005) find that adding of different concentrations of honey of ready to eat ground beef patties stored at 4°C for 12 days or frozen at-18°C for 45 days was delayed lipid oxidation and decreasing of TBA and lipid hydroperoxides. 5% of honey reduced TBA to 70% at 3 days of storage of ground Turkey at 4°C (Jason and Nicki, 2002).

References

Abd El-Aal, A.M., El-Hadidy, M.R., El-Mashad N.B., and El-Sabaie, A.H., (2007): Antimicrobial effect of Bee Honey in comparison to antibiotics on organisms isolated from infected burns. Annals of Burns and fire Disasters- vol. XX- n.2.

Adebolu, T.T. (2005): Effect of natural honey on local isolates of diarrhea causing bacte western Nigeria. African Journal of Biotechnology vol., 4 (10), pp. 1172 –1174.

Annas, Mothershaw and Taghreed Jaffer, (2004): Antimicrobial activity of food with differ chemical characteristics . J. Food protection vol., 7 , Issue 3, Page 629 –638 .

Antony, S, ; Rieck, J.R. ; Acton, J.C ; Han, I.Y. ; Holpin, E.L., ; and Dawson, P.L. , (2006 Dry Honey on the shelf-life of packaged Turkey slices, Poult, Science Journal, 85: .Antony, S.; Rieck, J.R. and Dawson, P.L. (2000): effect of dry honey on oxidatio breast meat. Poultry science, vol. 79, issue 12, 1876 – 1850.

AOAC (1990): Association of official analystic chemists official methods of analysis Washington DC.

APHA (1992):. Compendium of methods for microbiological examination of goods, Amer Health Association, 3rd Ed., Washington D.C.

Belewu, M.A. and Morakinyo, O.A. (2009): Nutritional, Microbiological and Sensory Ev Honey Treated and untreated doft cheese. European Journal of scientific Rese 1450 – 216 X vol. 26. No. 1, pp. 131-138 .

Cuzzoni, M.T. and Gazzani, G. (1984): Storage of frozen beef. Rivista dellasocie discienzadell, Alimenta Zione 13 (3), 146 Food Sci., Technol., Abs. 17 (10), 20.

Dawson, P (1998): Antioxidative properties of honey in poultry meat. Rep., National Hc Longmont colo, USA. Retrieved from www.nhb.org pg 1-4 .

Devore, V.R. (1988): TBA values and 7-Ketocholesterol in refrigerated raw and round b sci., 53 (4) : 1058 – 1061 .

Dodge, J.W. and Stadelmen, W.J. (1960): Relationships between PH, tenderness an levels during early postmortem ageing of Turkey meat. Food tecknol. 14, 43 .

EOS (2005). Egyptian standerds for chilling poultry and rabbits, ES: 1651 –2005 .

Fung, D. (2007): Tea time means and honey danger for listeria, E. coli. The food safety c Newsletter vol. 17, No. 1

Gomes, S.;. Dias, L. G.; Moreira, L.; Rodrigues, P. and Estevinho, L. (2010): Physic microbiological and antimicrobial properties of commercial honeys from Portugal Chemical Toxicology 48: 544–548.

Gray, J.I. and Crakal, E.L. (1992): oxidative flavor changes in meat : their origin and preve chemistry of muscle – based food (ed S.D.E. Johnston, K. Knigt and D.A. led W society of chemistry, London, pp, 145 .

Hashim, I.B. ; Mcwatters, K.H. ; and Hung, Y.C., (1999) Quality enhancement of chic without skin using Honey Marinades .Poultry science J., 78 : 1790-1795 .

ICMSF (1978): Microorganisms in food. Their significance and methods of enumerati University of Toronto press. Toronto, Buffalom London.

Jason, Mckibben and Nicki , J. Engeseth, (2002) : Honey as a protective agent a oxidation in Ground Turkey .J. Agric food chem., 50 (3) , pp. 592-595 .

Johnston, J.E. ; sepe, H.A. ; Miano, C.L and Brannan, R.G. (2005): Honey inhibits lipid ready-to-eat ground beef patties. Meat science volume 70, Issue 4, pages 627-631

Krushna, NS; Howsalya, A.; Radha, S. and Nara yanan, RB., (2007) : Honey a preservative of mik. Indian J. Experimental Biology, 45 (5): 459 –64 .

Labell, F. (1988): Honey: Traditional food finds new uses. Food process. 11 : 111 – 114 .

Marry L. Morr, (1970): Introductory foods, laboratory manual of food preparation and eval Ed., Macmillan publishing Co. Inc. New York , Coolier Macmillan publishers, Lond

Mundo, M.A., Padilla- Zakour O.I. and Worobo, R.W. (2004): Growth inhibition of pathogens and food spoilage organisms by select raw honeys. Int, J. Food micro – 8 .

Papan, M , Talon, R. and Montel, M.C (1990): the lipolytic flora af meat and meat produ et prodcits carnes 11 (2) : 49 – 55 .

Ranya M. Ewadah. (2005): survey on pseudomonas bacteria in milk sold in Assuit ci (M.Sc), faculty of vet. Medicine, Assuit unversity .

Selcuk, H. and Nevin, K. (2002): Investigation of antimicrobial effect of honey collected fr regions of Turkey. Pakistan J. of Biological Sci., 5, 3: 325-328.

Shotts, E.B., and Rimler, R.B (1973): Media for isolation of Aeromonas hydrophila. Applie 26 : 550-553 .

Snow, M.J. and Manley-Harris, M. (2004): on the nature of non-perioxde antibacterial acti Zealand Manuka honey. Food chem. J. 84: 145-147.

Tuley, L. (1989): don't forget the honey food manuf. , 64 : 24 – 25 .

Tumkar, R.S.; Yeleswarapa-Pauabhiran, S.J ; and Palle, S. (2002): Antibacterial effect c the in-vitro and in-vivo growth of E. coli .World of Microbiol. Biotechnol. 18 : 863 –

Viuda-Martos, M.; Ruiz-Navajas, Y.; Fernandez-lopez, J. ; Perez-Alvarez, J.A., (2007): functional properties of honey propolis and Royal Jelly. Journal of food science vol. 73, Issue J, pages R117-R124.

Vyncke, W. (1970): Direct determination of thiobarbituric acid value rancidity. Fette – Seifen Astric hmittel, 2: 1084 – 1087 .

White, Jonathan W., (1975): Composition of honey. In: Crane, E. (Ed.), Honey, A Comprehensive Survey, vol. 5. Heinemann, London, UK, pp. 157–206.

الملخص العربي

تقيم الجودة وفترة الصلاحية لشرائح الدجاج المتبل باستخدام عسل النحل المصري الصافي

تقوي حسين إسماعيل

قسم الرقابة الصحية علي الأغذية – معهد بحوث صحة الحيوان – معمل الإسماعيلية

تم في الدراسة تأثير إضافة عسل النحل الصافي إلي شرائح الدجاج المتبل على الجودة الحسّيّة والبكتريولوجية والكيميائيّة. لذلك تم استعمال عدد٦٠ شريحة لحم دجاج طازجة قسمت إلي ثلاث مجموعات وتم إضافة عسل النحل بتركيز صفر% (مجموعة ضابطة)، ٥% و١٠% على التّوالي ثم خزنت العينات عند درجة حرارة ٣ + ١ حيث تم الفحص الحسي والبكتريولوجي والكيميائي خلال فترات من ٠ ، ٢ ، ٤ ، ٦ ، ٨ و ١٠ يوما. وأظهرت النتائج أن معالجة شرائح الدجاج بتركيز ٥ ٪ و ١٥ ٪ عسل النحل يحسن المظهر العام والرائحة والاتساق ولون اللحم لمدة تصل إلى ١٠ أيام من التخزين. وكان العدد الكلي للبكتريا المحبة للبرودة في العينات المعالجة حتي اليوم العاشر من التخزين اقل من ١٠^٦ خلية لكل جرام بينما فسدت عينات المجموعة الضابطة بعد ٦ أيام تخزين وأظهرت النتائج تأثير عسل النحل الكابح بشكل عام علي مجموعة البكتريا المحبة للبرودة والمحللة للدهون وبشكل خاص على. أجناس الايرمونس والبسالس والايشيريشيا والسيدومونس والبروتيس والمكورات العنقودية. وأظهرت النتائج انخفاضا في قيمة الرقم الهيدروجيني والرطوبة في كل العينات المعالجة مقارنة بالمجموعة الضابطة واتضح تأثير عسل النحل علي مقاومة التزرنخ في الدهون لما حصلت عليه الدراسة من قيم لحامض الثايوباربتيورك طوال فترة التخزين. هذا وقد أوصت الدراسة بإمكانية استخدام عسل النحل على مستويات من ٥ ٪ و ١٥ ٪ كبديل طبيعي للمواد الحافظة الكيميائية في تنبيل شرائح الدجاج لتحسين الجودة وإطالة فترة التخزين تحت درجة حرارة التبريد.

Table (1)
Sensory evaluation of Fillet samples Treated with Honey stored at 4°C

Storage (day)	Control				Group 1 5% honey				Group 2 15% honey			
	A.	F.	C.	Co.	A.	F.	C.	Co.	A.	F.	C.	Co.
0	*10	10	10	10	10	10	10	10	10	10	10	10
2	8.0	8.2	8.2	8.3	8.5	8.2	8.2	8.5	8.5	8.2	8.2	8.0
4	7.5	7.0	6.5	7.2	6.5	8.4	8.2	8.0	8.5	8.7	8.5	7.5
6	7.0	6.5	6.5	7.0	8.3	8.3	8.0	7.5	8.4	8.5	8.2	7.0
8	5.6	5.6	5.0	5.2	7.8	7.9	7.8	7.0	8.2	8.5	8.2	7.0
10	*S	*S	*S	*S	7.0	7.2	7.0	6.8	8.0	8.0	8.0	6.5

A= Appearance F = Flavour C = Consistency Co = Colour
*S mean spoiled
Score 10 excellent 9 very good 8 good 7 medium 6 fair 5 poor

Table (2)
Bacteriological Values of Fillet samples Treated with Honey stored at 4°C

Storage (day)	Total Psychrophilic Counts						Total Lipolytic Psychrophilic Counts					
	Control		Group 1 5% honey		Group 2 15% honey		Control		Group 1 5% honey		Group 2 15% honey	
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E
0	3×10^3	$2x10^2$	4×10^2	$1.5x10^2$	3×10^2	$1.1x10^2$	6×10^2	$2x10^2$	2×10^2	$5.2x10^2$	2×10^2	$4.5x10^2$
2	8×10^3	$3x10^2$	$8x 10^2$	$1.8x10^2$	4×10^2	$2.3x10^2$	1×10^3	$3.1x10^3$	6×10^2	$2.1x10^2$	4×10^2	$2.4x10^2$
4	9×10^4	$2x10^2$	6×10^3	$2x10^2$	6×10^3	$12x10^2$	9×10^3	$2.4x10^3$	2×10^3	$2x10^2$	3×10^3	$3.1x10^2$
6	4×10^5	$2.1x10^3$	8×10^4	$3x10^2$	2×10^4	$3x10^2$	2×10^4	$2x10^2$	7×10^3	$5x10^2$	6×10^3	$2x10^2$
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1×10^5	$5x10^3$	[illegible]	[illegible]	[illegible]	$2x10^3$	2×10^4	$3x10^3$

Table (3)

Bacterial strains of Fillet samples Treated with Honey stored at 4°C

Strains	Control					Group 1 5% honey						Group 2 15% honey					
	0	2	4	6	8	0	2	4	6	8	10	0	2	4	6	8	10
A. hydrophila	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. cereus	+	+	+	+	+	+	+	+	-	-	-	+	+	+	-	-	-
Citrobacter diversus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
E. coil	+	+	+	+	+	+	+	+	-	-	-	+	+	-	-	-	-
Micrococcus roseus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Staph. aureus	+	+	+	+	+	+	+	+	-	-	-	+	+	-	-	-	-
Entero. spp	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pseudoomonas spp	+	+	+	+	+	+	+	+	-	-	-	+	+	+	-	-	-
Proteus spp	+	+	+	+	+	+	+	+	-	-	-	+	+	+	-	-	-

+ Detected - Not detected

Table (4)

Values of Quality Parameters for Fillet samples Treated with Honey stored at 4°C

Storage (Day)	PH			Moisture %			TBA (mg/100g)		
	Control	5% honey	15% honey	Control	5% honey	15% honey	Control	5% honey	15% honey
0	5.56 + 0.103	5.03 + 0.51	5.13 + 0.034	67.2 + 0.06	43.6 + 0.13	38.2 + 0.03	0.045 + 0.03	0.041 + 0.01	0.029 + 0.019
2	5.20 + 0.06	5.08 + 0.035	5.16 + 0.032	65. 3 + 0.04	55.6 + 0.04	47.4 + 0.06	0.069 + 0.05	0.063 + 0.03	0.038 + 0.014
4	5.66 + 0.05	5.39 + 0.041	5.00 + 0.065	28.8 + 0.12	23.6 + 0.13	21.2 + 0.12	0.068 + 0.03	0.046 + 0.02	0.042 + 0.028
6	6.06 + 0.032	5.48 + 0.062	5.55 + 0.069	57.2 + 0.02	51.6 + 0.042	48.8 + 0.32	0.072 + 0.063	0.015 + 0.19	0.025 + 0.025
8	6.25 + 0.051	5.39 + 0.03	5.65 + 0.026	64.3 + 0.032	47.6 + 0.02	51.4 + 0.04	0.100 + 0.08	0.039 + 0.01	0.023 + 0.18
10	*	5.62 + 0.046	5.68 + 0.032	*	53.8 + 0.03	52.2 + 0.03	*	0.057 + 0.03	0.054 + 00.02

* spoiled