

USING GELATIN TO PRODUCE HONEY JELLY FROM CITRUS, CLOVER AND COTTON LIQUID HONEY

A.M. ABD ELHAMID¹, H.F. ABOU-SHAARA^{2,*}

*E-mail: hossam.farag@agr.dmu.edu.eg

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ABSTRACT. The liquid form of honey is relatively undesirable because honey could be crystallized and then spoilage under certain conditions. In this study, producing honey jelly from liquid citrus, clover and cotton honey using gelatin was investigated. Only gelatin and water were used to produce the honey jelly without other additives. Some chemical components were then determined in produced honey jelly of each type, in comparison with components of liquid honey. The results showed that solid honey jelly can be obtained using 10 g gelatin dissolved in 50 ml per 200 g honey. Using different amounts of gelatin and water did not show significant impact on measured components of produced jelly. Liquid honey had significantly higher percentage of sugars than jelly honey. The variations between the two types of honey were about 9.9, 9.7, and 9.75% for fructose, 13.5, 19.86 and 19.15% for glucose, 2.44, 1.85, and 1.7% for sucrose, for citrus, clover and cotton, in respect. The viscosity of honey jelly was significantly higher (from 82 to 90.66 poise) than liquid honey (from 31.63 to 63.86 poise) for each honey type.

The moisture ranged insignificantly ($P > 0.05$) from 36.03 to 38.36% for honey jelly, and insignificantly ($P > 0.05$) from 17.35 to 20.00% for liquid honey of all honey types; pH values showed insignificant variations between liquid honey and honey jelly. Fructose and moisture of liquid honey showed insignificant weak correlation with components of honey jelly. Glucose, sucrose and pH of liquid honey are correlated significantly by 88%, 86%, and 84% with percentages of glucose and sucrose, and pH of honey jelly, respectively. Producing honey jelly using gelatin could be considered as a promising product from liquid honey to encourage bee honey marketing.

Keywords: bee honey; gelatin; citrus; clover; cotton; jelly.

INTRODUCTION

Honey is well known as nutritive and medicinal food. Liquid, creamed

¹ Department of Food and Dairy Science and Technology, Faculty of Agriculture, Damanhour University, Egypt

² Department of Plant Protection, Faculty of Agriculture, Damanhour University, Egypt

(full crystallized) and chunk honeys are the common marketable forms of honey. Each form of honey has its own characteristics. The liquid form of honey is somewhat undesirable because it could be partially crystallized or fermented over time. Also, there are some limitations during packing and marketing. Turning liquid honey into more solid form could help in solving such problems. Also, solid honey could be utilized as additive to some dairy or food products, especially when liquid honey is not possible to be added. It is known that adding bee products to dairy products could enhance their nutritional and medicinal values. For instance, Metry and Owayss (2009) have found the quality of yoghurt was enhanced when it has been mixed with 4% bee honey and 0.2% or 0.6% royal jelly. Creamed honey as a solid form of honey can not be used as additive to some food products due to its granular nature. Also, the production of creamed honey takes relatively long time about 14 days (Abd Elhamid and Abou-Shaara, 2016) based on the production method and storing temperature. Still, searching for a method to turn liquid honey to solid form is strongly required to overcome problems related to liquid form.

Gelatin is known as a material for foods' gelation (Mariod and Adam, 2013), and is used widely with different sweet foods. It also can help in enhancing gelation of yogurt (Supavititpatana *et al.*, 2008). It is hypothesized that gelatin could be

directly used to make honey jelly from liquid honey with few alternations in honey properties. Approximately, there are no available literatures about using gelatin directly with honey. But previous studies have depended on mixing honey with juice and citric acid beside other materials to produce jelly. For example, DaoMei and ZhenQiong (2011) have produced yam and honey jelly using yam juice, honey: sugar syrup (1:1), citric acid, and xanthan gum: sodium alginate (1:3) with percentages of 20, 15, 0.20, and 1%, respectively. Therefore, in this study the potential of using commercial powdered gelatin to produce honey jelly was investigated. Various amounts of gelatin (treatments) were tested. The common honey types (citrus, clover and cotton) in Egypt were used in this study. Also, the chemical properties of the produced honey jelly were compared with liquid honey of each type to detect changes. The best treatment was then recommended to produce honey jelly.

MATERIALS AND METHODS

Honey samples

Citrus, clover and cotton honeys were collected from different three apiaries within El-Behera governorate, 30° 36' 36" N and 30° 25' 48" E, Egypt. These three types of honey are the main honeys in Egypt (Husseini, 2001).

Producing honey jelly

Some pre-experiments were performed using different amounts of powdered gelatin (from animal sources,

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i.e. cows and buffalos, Al-Ahram Company, Egypt). The most successful trials were: 1) using 10 g dissolved in 100 ml water (treatment 1), 2) using 10 g dissolved in 50 ml water (treatment 2), and 3) 5 g dissolved in 50 ml water (treatment 3). Each treatment was mixed with 200 g of liquid honey. The three treatments were done with the tested honey types (per each honey type: 2400 g were used from the three regions, 800 g per region, 200 g per treatment, and 200 g of liquid honey for chemical analysis). Producing of honey jelly was done using water bath. Gelatin dissolved in water was firstly added and then directly honey was added and mixed with gelatin for about one minute. The mixture was then poured in Petri dishes and left on room temperature to loss heat. The honey jelly was then stored in normal refrigerator at about 5°C till chemical analysis.

Investigated parameters

Samples of jelly and liquid honey from each treatment were subjected to chemical analysis and methods of AOAC (1990 and 2000) were utilized. Samples were firstly wormed at $40 \pm 1^\circ\text{C}$ for 30 min. To determine the moisture %, 2.0 g of each sample was dried to constant weight in hot air oven at 70°C , and then moisture was calculated on dry basis. To measure pH, a digital pH meter (Model HI 9321; HANNA, Portugal) was used at 40°C . Sucrose content was determined by adding 10 mL of dilute HCl, 50 mL of diluted honey solution and water in a 100 mL volumetric flask. The solution was then heated in a water bath, cooled and diluted to the mark. Finally, the Layne-Enyon method was applied, and the sucrose content was obtained by difference. The resorcinol reagent method was used to determine glucose and fructose content. Viscosity was

determined using Brookfield viscometer (Model HAT Brookfield Engineering, MA, 02072, USA) at 20°C as described by Acton and Saffle (1971).

Statistical analysis

Three treatments (gelatin/water) to produce honey jelly beside liquid honey were used in this research with three replicates (apiaries). SAS 9.1.3 program (SAS, 2004) was used to perform the statistical analysis. Means \pm S.E. of determined characteristics were firstly calculated. Then, ANOVA was performed and means were compared using Tukey's studentized range test_{0.05}. Pearson correlation coefficients (r values) at 5% level of significance between measured characteristics of liquid and honey jelly, and gelatin/water treatments were calculated.

RESULTS AND DISCUSSION

General appearance

As show in *Figure 1*, produced jelly from the three honey types differed in its color and solidity. The color was different due to the natural differences in color of liquid honey in relation to the floral sources. In line with El Sohaimy *et al.* (2015), they found that honey color differed according to plant origin of honey in their analyzed samples. Clover is darker than citrus, and cotton has somewhat reddish color. The solidity differed according to treatment. For all honey types, honey jelly produced using 10 g of gelatin dissolved in 50 ml of water was more solid than other treatments (*Figure 2*). Also, using 10 g of gelatin dissolved in 100 ml of water was more solid than using

5 g dissolved in 50 ml of water. This is explained by the role of gelatin in solidifying the liquid bee honey.

Using more gelatin dissolved in few water mixed with liquid honey produced more solid jelly.

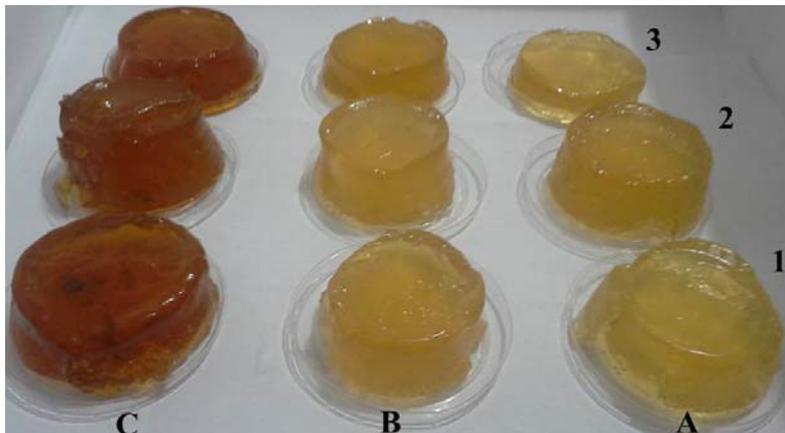


Figure 1 - Samples of produced jelly from citrus (A), clover (B) and cotton (C) honey using three treatments 1, 2 and 3.

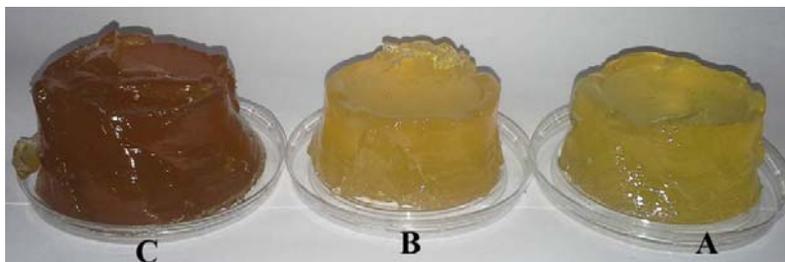


Figure 2 - Samples of honey jelly produced using treatment 2 (the most solid jelly) of citrus (A), clover (B) and cotton (C) honey.

Characteristics of citrus, clover and cotton honey jelly

As shown in *Table 1*, the percentages of fructose, glucose and sucrose were significantly ($P < 0.05$) lower in honey jelly than liquid honey of all types. The differences were about 9.9, 9.7, and 9.75% for fructose, 13.5, 19.86 and 19.15% for glucose, 2.44, 1.85 and 1.7% for sucrose, for citrus, clover and cotton, in respect. This could be explained by gelatin role in holding water and soluble

components during gelation process. Thus, the determined sugars from jelly samples were lower than those of liquid honey. This also is supported by the taste of the honey jelly, which was less sugary than liquid one. Moreover, the production process could impact the sugars content according to Semkiw *et al.* (2009), they found slight reduction in sucrose content, when honey was dehydrated under controlled conditions. The gelatin treatments (amount of

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gelatin/water) in all honey types did not show any significant impacts on percentage of sugars. The highest percentages of fructose and glucose were detected in clover honey, while the highest percentage of sucrose was detected in citrus honey. These differences are explained by variations in the floral sources. Liquid and jelly honey of all types did not show significant differences in regard to percentage of fructose, while percentages of glucose and sucrose differed significantly in clover and cotton honey than citrus one.

Table 1 showed that all honey jelly produced using different gelatin treatments for each honey type and among honey types had insignificantly ($P > 0.05$) the same viscosity. The viscosity of honey jelly was significantly higher (from 82 to 90.66 poise) than liquid honey (from 31.63 to 63.86 poise) for each honey type. These variations could be due to the role of gelatin in increasing viscosity. The viscosity of liquid honey differed significantly among honey types. This could be explained by the natural variations in liquid honey due to the floral resource.

The moisture ranged insignificantly ($P > 0.05$) from 36.03 to 38.36% for honey jelly, and insignificantly ($P > 0.05$) from 17.35 to 20.00% for liquid honey of all honey types (*Table 1*). The determined moisture of clover and cotton honey in the present study is within the range from 14.73 to 18.32%, detected by El Sohaimy *et al.* (2015) for Egyptian honey and some

other honey types. Also, within the range from 15.1 to 17.71% detected by Abd Elhamid and Abou-Shaara (2016) for creamed clover and cotton honey. The slight increase in moisture of liquid citrus honey could be attributed to the time of extraction and handling conditions. The present results of moisture of clover and cotton honey are slightly lower by 1.53% than those determined by Hamdy *et al.* (2009) and this could be also explained by handling and extraction process of liquid honey. The moisture of honey jelly differed significantly ($P < 0.05$) than the moisture of liquid honey of tested honey types.

For each honey type, pH values showed insignificant variations between liquid honey and honey jelly. The pH values from 3.6 to 4.2 are in accordance with the study of El Sohaimy *et al.* (2015), they recorded high acidity in Egyptian honeys than Saudi and Kashmiri honey, within a range from 3.4 to 6.1. Also, Abd Elhamid and Abou-Shaara (2016) recorded a range from 3.41 to 4.35 for creamed clover and cotton honey. On the contrary with Supavitpatana *et al.* (2008), they found increase in yogurt acidity due to increasing levels of gelatin, but in the present study honey acidity showed no significant change due to gelatin treatments. Among honey types, pH of liquid and jelly citrus honey differed significantly than clover and cotton honey. This is due to the natural variations among honey types.

Table 1 - Mean±S.E. of fructose, glucose, sucrose, viscosity (poise), moisture, and pH for citrus, clover, and cotton honey jelly produced using different amounts of gelatin, and liquid honey of each type

Treatment*	Mean ± S.E.**						
	Fructose %	Glucose %	Sucrose %	Viscosity	Moisture %	pH	
Citrus	A	27.13± 1.61 ^b	7.69± 0.46 ^c	1.39± 0.08 ^c	83.70± 3.89 ^a	38.36± 3.40 ^a	3.69± 0.02 ^c
	B	27.02± 1.58 ^b	7.68± 0.49 ^c	1.37± 0.08 ^c	84.00± 3.05 ^a	38.44± 3.41 ^a	3.70± 0.04 ^c
	C	27.02± 1.61 ^b	7.65± 0.48 ^c	1.40± 0.08 ^c	82.00± 3.60 ^{ab}	38.40± 3.48 ^a	3.70± 0.06 ^c
	L	37.01± 0.10^a	21.17± 0.10^b	3.81± 0.06^a	31.63± 0.81^c	20.00± 0.05^b	3.60± 0.01^c
Clover	A	27.55± 1.65 ^b	11.43± 0.68 ^b	1.06± 0.06 ^{cd}	89.36± 4.66 ^a	36.57± 3.49 ^a	4.07± 0.08 ^b
	B	27.54± 1.63 ^b	11.52± 0.70 ^b	1.11± 0.04 ^{cd}	89.33± 4.38 ^a	36.38± 3.47 ^a	4.09± 0.10 ^b
	C	27.51± 1.64 ^b	11.37± 0.72 ^b	1.12± 0.03 ^{cd}	89.96± 4.62 ^a	36.43± 3.59 ^a	4.10± 0.10 ^{ab}
	L	37.28± 0.37^a	31.23± 0.11^a	2.91± 0.05^b	63.86± 0.82^b	17.50± 0.05^b	4.10± 0.06^{ab}
Cotton	A	26.60± 1.60 ^b	11.03± 0.66 ^b	0.94± 0.05 ^d	90.66± 4.84 ^a	36.13± 3.49 ^a	4.36± 0.03 ^{ab}
	B	26.57± 1.60 ^b	10.99± 0.68 ^b	0.91± 0.09 ^d	90.66± 4.48 ^a	36.06± 3.51 ^a	4.38± 0.08 ^{ab}
	C	26.56± 1.56 ^b	11.15± 0.67 ^b	1.00± 0.05 ^d	90.33± 4.70 ^a	36.03± 3.51 ^a	4.36± 0.04 ^{ab}
	L	36.31± 0.11^a	30.14± 0.08^a	2.61± 0.05^b	42.30± 0.52^c	17.35± 0.19^b	4.42± 0.01^a

*A: using 10 g dissolved in 100 ml water, B: 10 g dissolved in 50 ml water, C: 5 g dissolved in 50 ml water, L: liquid honey. **All means in the same column, followed by the same letter are not significantly different according to Tukey's studentized range test_{0.05}.

As shown in *Table 2*, fructose and moisture of liquid honey showed insignificant weak correlation with components of honey jelly. Glucose, sucrose and pH of liquid honey are correlated significantly by 88%, 86% and 84% with percentages of glucose and sucrose, and pH of honey jelly, respectively. This indicates that percentage of sugars of liquid honey can impact sugars content of produced

jelly from it greatly. A significant negative correlation (-86%) was found between pH and moisture content. Viscosity of liquid honey is correlated significantly by 55% with this of honey jelly. It is clear that a significant negative correlation of -40% was detected between viscosity and moisture. This means that high water content in liquid honey reduced viscosity.

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Table 2 - Correlations (r and P- value) between fructose, glucose, sucrose, viscosity (poise), moisture, and pH of jelly and liquid honey

Factor	Honey jelly						
	Fructose %	Glucose %	Sucrose %	Viscosity	Moisture %	pH	
Liquid honey	Fructose	-0.04	-0.19	0.33	-0.19	0.18	-0.49
	<i>P</i> -value	0.82	0.32	0.08	0.32	0.36	0.008*
	Glucose	0.02	0.88	-0.78	0.45	-0.19	0.80
	<i>P</i> -value	0.90	<0.0001*	<0.0001*	0.01*	0.32	<0.0001*
	Sucrose	0.05	-0.82	0.86	-0.49	0.21	-0.90
	<i>P</i> -value	0.78	<0.0001*	<0.0001*	0.0092*	0.29	<0.0001*
	Viscosity	0.12	0.72	-0.41	0.33	-0.15	0.38
	<i>P</i> -value	0.52	<0.0001*	0.03*	0.09*	0.45	0.04*
	Moisture	0.07	-0.83	0.85	-0.40	0.13	-0.86
	<i>P</i> -value	0.69	<0.0001*	<0.0001*	0.03*	0.50	<0.0001*
	pH	0.04	0.82	-0.81	0.55	-0.30	0.94
	<i>P</i> -value	0.80	<0.0001*	<0.0001*	0.002*	0.11	<0.0001*

*Correlations are significant.

As shown in *Table 3*, gelatin amount of 5 or 10 g and amount of water (either 50 or 100 ml) had weak (from -0.06% to 1%) and insignificant correlations with determined components in honey jelly. This explains the lacking of significant differences between determined

components of honey jelly produced using different amounts of gelatin and water. Moreover, this supports the idea that changes in honey jelly than liquid honey are essentially due to the physical properties of gelatin instead of its amount.

Table 3 - Correlations (r and P- value) between amount of gelatin/ water and fructose, glucose, sucrose, viscosity (poise), moisture, and pH of jelly honey

Factor	Honey jelly					
	Fructose %	Glucose %	Sucrose %	Viscosity	Moisture %	pH
Gelatin amount	0.008	-0.0006	-0.09	0.03	0.003	-0.01
<i>P</i> -value	0.96	0.99	0.64	0.85	0.98	0.93
Water amount	0.01	-0.003	-0.04	0.01	0.005	-0.02
<i>P</i> -value	0.95	0.98	0.82	0.94	0.97	0.89

CONCLUSION

Jelly from citrus, clover and cotton honey can be obtained directly using only gelatin dissolved in water.

To obtain solid honey jelly, using 10 g gelatin dissolved in 50 ml per each 200 g honey is advisable. The addition of gelatin to produce honey jelly caused alteration in chemical

composition in resulted jelly over liquid honey. Basically, it caused reduction in tested components except viscosity and moisture, which increased. Studying suitable storing temperatures of produced honey jelly and impacts on the nutritional value could be considered as recommended future studies.

REFERENCES

- Abd Elhamid, A.M. & Abou-Shaara, H.F. (2016)** - Producing clover and cotton creamed honey under cooling conditions and potential use as feeding to honey bee colonies. *J. Apic.*, 31:59-64.
- Acton, J.C. & Saffle, R.L. (1971)** - Stability of oil-in-water emulsions. 2. effect of oils phase volume, stability test, viscosity, type of oil and protein additives. *J. Food Sci.*, 36:1118-1120.
- AOAC (1990)** - Food composition, additives and natural contaminants. In Helrich, K. (Eds). Official methods of analysis. USA: Association of official analytical chemists international 2, Arlington.
- AOAC (2000)** - Sugars and sugar products. In Horwitz, W. (Eds). Official methods of analysis. USA: Association of official analytical chemists international, 2 (44), Washington, DC 22-33.
- DaoMei, C. & ZhenQiong, H. (2011)** - Optimization of the production process of yam and honey jelly. *Med. Plant*, 2:55-59.
- El Sohaimy, S.A., Masry, S.H.D. & Shehata M.G. (2015)** - Physicochemical characteristics of honey from different origins. *Ann. Agri. Sci.*, 60:279-287.
- Hamdy, A.A., Ismail, H.M., AL-Ahwal, Ael-M. & Gomaa, N.F. (2009)** - Determination of flavonoid and phenolic acid contents of clover, cotton and citrus floral honeys. *J. Egypt. Public. Health. Assoc.*, 48:245-259.
- Hussein, M.H. (2001)** - Beekeeping in Africa: I-north, east, north-east and west African countries. Proceedings of the 37th International Apicultural Congress, Durban, South Africa.
- Mariod, A.A. & Adam, H.F. (2013)** - Review: gelatin, source, extraction and industrial applications. *Acta Sci. Pol. Technol. Aliment*, 12(2):135-147.
- Metry, W.A. & Owayss, A.A. (2009)** - Influence of incorporating honey and royal jelly on the quality of yoghurt during storage. *Egypt. J. Food Sci.*, 37:115-131.
- SAS (2004)** - The SAS System Version 9.1.3. SAS Institute. Cary. NC, The USA.
- Semkiw, P., Skowronek, W., Skubida, P., Rybak-Chmielewska, H. & Szczęśna, T. (2009)** - Changes on saccharide composition of honey during ripening under controlled conditions. *J. Apic. Sci.*, 53(1): 81-93.
- Supavitpatana, P., Wirjantoro, T.I., Apichartsrangkoon, A., Raviyan, P. (2008)** - Addition of gelatin enhanced gelation of corn-milk yogurt. *Food Chem.*, 106:211-216.