

## Exploring the potential of Arhar honey (*Cajanus Cajan*) in alleviating hematological indices in prediabetes state

Seema Rana<sup>1</sup>, Charu Katare<sup>2</sup>, Senthil Kumar Subramani<sup>3</sup>, GBKS Prasad<sup>4</sup>

<sup>1</sup>Diabetes, Obesity & Thyroid Center, Gwalior, Madhya Pradesh, India

<sup>2</sup>Department of Home Science Food and Nutrition, Government KRG Post Graduate Autonomous College, Gwalior, Madhya Pradesh.

<sup>3</sup>NSK Provital Foods, Lucknow, Uttar Pradesh, India

<sup>4</sup>Center for Translational Research, SOS in Biochemistry, Jiwaji University, Gwalior, Madhya Pradesh, India.

**Corresponding author's Email:** cskatare@gmail.com

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### Abstract

**Background:** Prediabetes manifesting impaired glucose tolerance is a risk state that has potential to develop in type 2 diabetes and cardiovascular disease (CVD). Hyperglycaemia and haematological parameters are reported to have significant association. Low glycaemic index foods help in alleviating hyperglycemia. Arhar Honey (*Cajanus cajan*) being low glycaemic index (GI) natural food may possibly maintain normal haematological parameters in prediabetic state.

**Aims and Objectives:** This study compared effect of honey administration on haematological indices of pre-diabetic and non-diabetics subjects.

**Materials and Methods:** Sixty individuals in the age group of 40-60 years were subjected to an oral glucose tolerance test (OGTT) and were categorized as individuals exhibiting normal glucose tolerance or non-diabetic (n=30) and individuals having impaired glucose tolerance or prediabetic (n=30) using WHO criteria. The subjects in both the groups were administered with 70 gms of honey on empty stomach for a duration of 60 days and its effect on FBG, HbA1c and hematological parameters viz. hemoglobin (Hb), red blood cell count (RBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) was measured.

**Results:** A remarkable improvement ( $p < 0.01$ ) in Hb and RBC was demonstrated in non-diabetic as well as prediabetic group and a significantly high modulating effect of honey was observed on PCV value in prediabetic group as compared to non-diabetic group.

**Conclusion:** Administration of Arhar honey for a period of 60 days improved selected hematological indices in non-diabetic and prediabetic subjects.

**Keywords:** Natural food, honey, glycemic control, haematological parameters, cardiovascular risk

### How to cite this article

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### Introduction

The natural history of illness of diabetes mellitus (DM) caused by insulin resistance and reduced insulin secretion

in pancreatic beta cells will include the pre-diabetic phase.<sup>1, 2, 3</sup> The dramatic increase in incidence of diabetes has prompted efforts to identify individuals who have milder glucose intolerance,<sup>4, 5</sup> because early management with lifestyle change and/or medication can delay progression

to diabetes with its attendant morbidity, mortality, and cost.<sup>6</sup> Pre-diabetes is categorized into impaired fasting glucose (IFG) when the blood glucose level is 100 mg/dL – 125mg/dL and impaired glucose tolerance (IGT) when the 2-hour-after 75 gram oral glucose load level Oral Glucose Tolerance Test (OGTT) ranges between 140-199 mg/dL.<sup>7,8</sup> Prediabetes is a considerable menace issue for development of diabetes mellitus along with macrovascular disease and retinopathy.<sup>9</sup> Initial accumulation of excess free fatty acids in adipose tissue with non-adipose tissue like liver, muscle, and pancreas takes place during the prediabetic phase.<sup>10</sup>

Blood is characterized as a connective tissue comprising cellular elements. Elevated blood glucose level in T2DM contributes to disturbance of blood cells and its indices.<sup>11</sup> Renewed interests towards the association of haematological parameters and elevated blood glucose demands the requirement of improving the hematological parameters in subjects with IGT. The hematological parameters considered important in this context are white blood count (WBC), mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), platelet count, platelet to lymphocyte ratio (PLR) and neutrophil to lymphocyte ratio (NLR) and endothelial dysfunction and inflammation.<sup>12-14</sup> Numerous animal and human studies have shown a positive effect of administration of honey on haemoglobin and other haematological parameters.<sup>15</sup> As subjects with IGT are at increased risk of progression

to diabetes, it is important to halt the abnormality in haematological parameters at this stage to prevent further complications.<sup>16</sup>

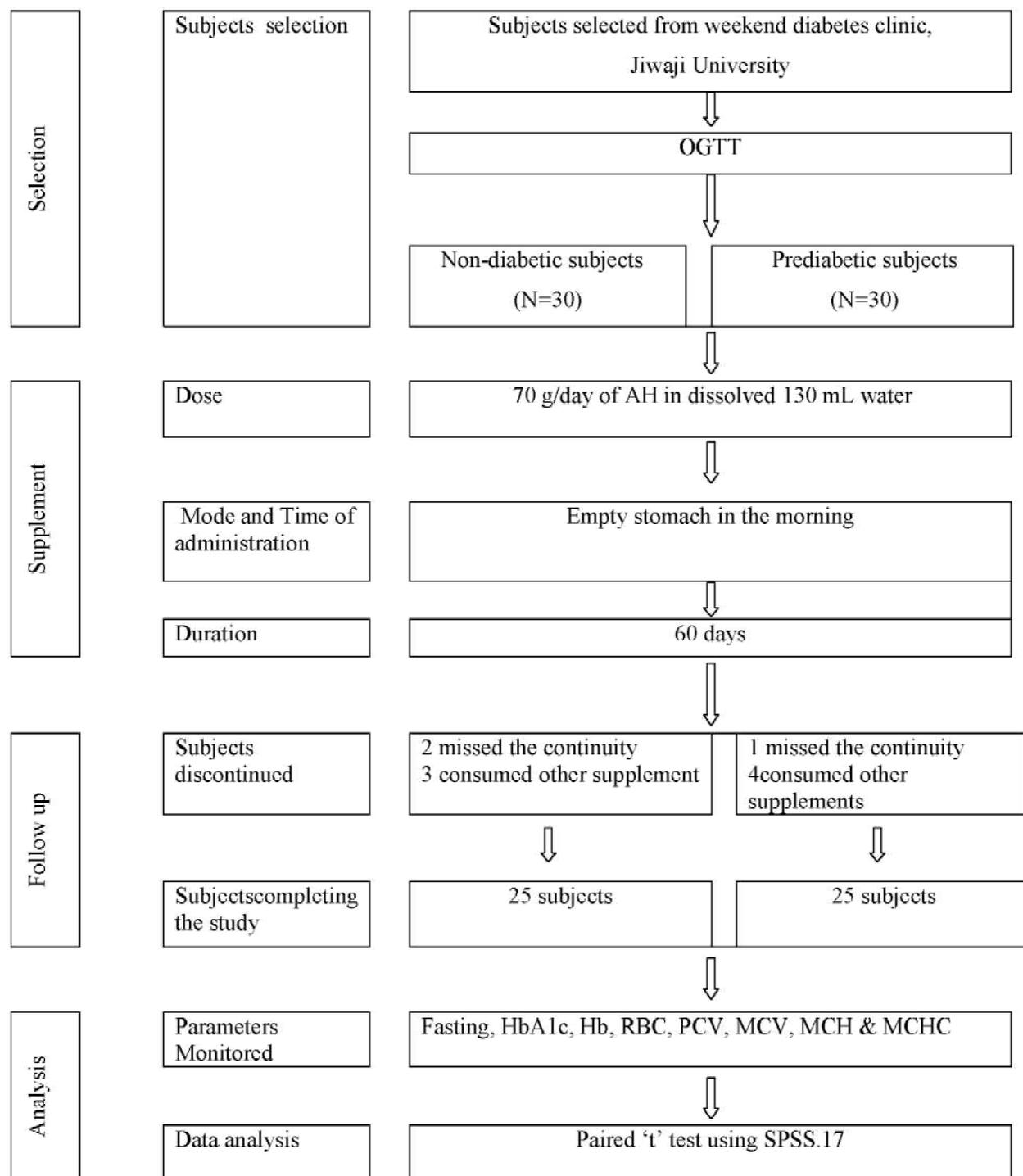
Based on the flower source, varieties of honey are available in the market. Arhar honey (AH) collected from the Pigeon pea flowers (*Cajanus cajan*) was procured from Krishi Vigyan Kendra (KVK) Morena district, near Gwalior, MP, India as, it was found to exhibit lower glycemic index as compared to other available varieties during the study period.<sup>17</sup>

This study aimed to evaluate the potential ameliorative role of AH on glycemic status and selected haematological parameters of non-diabetic and prediabetic subjects.

### **Material and Methods**

The study was conducted at Centre for Translational Research, School of Studies in Biochemistry, Jiwaji University Gwalior, where a diabetic clinic runs every weekend. The subjects who attended the diabetic clinic within the age group of 40-60 years were asked to undergo an OGTT. The subjects were instructed not to consume unusually large meals, alcohol and undergo vigorous exercise on the preceding day of the test. After an overnight fast of at least 10-12 hours, all the participants underwent a standard 75-g OGTT. Participants identified as having impaired glucose tolerance (IGT) as per WHO criteria were categorized as prediabetic subjects.

Fig. 1 : Outline of the study



The subjects were also advised to not to change their food habits and lifestyle during the study period. A written consent was obtained from each participant before registering for the study. The study protocol was duly approved by the Institutional Human Ethics Committee (JU/IHEC/20/13-A/18). Participants who consumed honey or any form of herbal extract in past the 3 months before enrolling in the study, and individuals with chronic diseases, pregnant women, and those who indicated a history of drug or alcohol abuse were excluded from the study.

Subjects in the non-diabetic as well as prediabetic group were administered with 70 g/day of AH dissolved in 130 mL water on empty stomach every day early in the morning, consecutively for 60 days. Attendance was maintained throughout the study period so that regular consumption of honey was ensured.

Fasting blood glucose level, HbA1c and haematology parameters were measured at baseline and at 60th days of the study period. Blood glucose was assessed by GOD-

POD method,<sup>18</sup> HbA1c by Colorimetric method,<sup>19</sup> Hb by Sahli method,<sup>20</sup> RBC, MCV, MCH, MCHC and PCV by Macrohaematocrit method,<sup>21</sup>. Outline of the study is presented in fig 1.

All the data analysis was performed using IBM SPSS ver. 17 software. Data of glycaemic parameter and complete blood profile of subjects is expressed as mean and standard deviation whereas percentage change is expressed as percentage. Paired t test was used to compare the mean. P value of <0.05 is considered as significant.

### Results

The subjects in the non-diabetic and prediabetic group were administered 70g honey for a period of 60 days. The study revealed that AH honey supplementation considerably reduced FBG (9.8%) in the non-diabetic group compared to the prediabetic group (6.5%). HbA1c level was also reduced by 4.1% and 3.0 % respectively in the prediabetic group and the non-diabetic group. (Table:1)

**Table 1: Effect of 60 days of honey supplementation on blood parameters**

Parameters	Non-Diabetic (N=25)			Prediabetic (N=25)		
	Before	After	% change	Before	After	% change
FBG	95.67± 1.35	86.24±1.73 **	9.86	99.42±1.68	92.95±1.30**	6.50
HbA1c (%)	4.18±0.14	4.01±0.14	4.10	5.16±0.15	5.00±0.13*	3.06
Hb (g %)	12.76±0.29	13.94±0.28* *	9.24	13.02±0.19	14.10±0.25**	8.26
RBC (millions/mm <sup>3</sup> )	4.14±0.13	4.90±0.18**	18.28	3.89±0.09	4.51±0.15**	16.14
PCV (%)	41.72±0.94	43.64±0.98	4.60	40.08±0.71	42.64±0.68**	6.39
MCV (c <sup>u</sup> (μ <sup>3</sup> ))	101.51±1.38	91.76±3.93*	9.60	104.98±2.44	97.31±4.11	7.31
MCH (μ g)	31.17±0.69	29.27±1.11	6.11	33.85±0.75	31.97±1.07	5.55
MCHC (%)	30.66±0.47	32.07±0.48*	4.58	32.35± 0.53	33.13±0.49	2.40

Note: Data is expressed as mean ± standard error, \* P value <0.05, \*\* P value <0.001

It was observed that supplementation of AH remarkably improved haematological parameters i.e., Hb (9.2%), RBC (18.2%), and PCV (4.6%) in the prediabetic group. A noteworthy improvement was also observed in the non-diabetic group, whereas MCV showed a significant decrease ( $p < 0.05$ ) and MCHC increased respectively in both groups. Details are provided in table 1.

## Discussion

Individuals with prediabetes are reported to be at high risk of developing diabetes and advancing to its complication.<sup>22</sup> Therefore, identifying prediabetes is worthwhile so that preventive measures may be taken. Earlier high prevalence (5.7%) of prediabetes in Gwalior-Chambal region has been reported. The incidence of prediabetes is alarmingly increasing diabetes risk in this area.<sup>16</sup> The number of prediabetic individuals is at a high level worldwide and they have an increased risk of developing diabetes, causing severe physical impairment and heavy financial burden. Recently, use of various dietary supplements is increasingly common, in different diseases. The effects of dietary supplements have been confirmed in some studies among prediabetic individuals.<sup>23</sup> Honey is the natural sweetener reported to exhibit low glycemic response and glycemic index compared to common sweeteners.<sup>17</sup>

In a study, honey tolerance in prediabetic subjects was assessed. The finding has demonstrated the ameliorating effect of honey on selected biochemical parameters in prediabetic subjects within the experimental groups.<sup>24</sup> As apparent from the results obtained in our study, the mean difference in FBG values indicated a significant reduction ( $p < 0.01$ ) in non-diabetic and prediabetic groups when compared with the baseline values. A significant lowering ( $p < 0.05$ ) of HbA1c was observed in the prediabetic group with a considerable improvement in the non-diabetic group. Similar effect of tualang honey has been reported in a study. However, based on current literature, one may suggest that tualang honey might possibly exert its hypoglycaemic effect through fructose which is its

predominant constituent.<sup>25</sup> Fructose neither increases plasma glucose nor its metabolism requires insulin secretion.<sup>26</sup> Dietary fructose is known to activate glucokinase which is a key enzyme involved in the intracellular metabolism of glucose. It catalyzes the conversion of glucose to glucose-6-phosphate thereby decreasing blood glucose.<sup>27</sup> The findings of yet another study revealed that fructose stimulated insulin secretion from an isolated pancreas.<sup>28</sup> Individuals with lower haemoglobin without anaemia had higher HbA1c at the same fasting glucose level within the non-diabetic range.<sup>29</sup>

Prediabetic subjects have high risk of developing diabetes and honey has a very long history of low-risk food use.<sup>30</sup> According to a study, honey administration reduced PGL (plasma glucose level) and insulin in normal subjects compared with dextrose administration. Therefore, with use of honey development of hyperinsulinemia may be avoided, as encountered with other sources of carbohydrates. Honey contains fructose in addition to various minerals and antioxidants. Small amounts of fructose could increase hepatic glucose uptake and glycogen storage and reduce glycemia and insulin levels.<sup>31</sup>

In the present study, we evaluated the role of Arhar honey on the selected haematological parameters viz. Hb, RBC, PCV, MCV, MCH and MCHC. Monitoring of haematological parameters on the administration of Arhar honey for 60 days, a significant increase ( $p < 0.01$ ) in Hb and RBC; was demonstrated in the non-diabetic group and the prediabetic group.

Earlier Noori S reported that honey increased serum iron by 20% and decreased plasma ferritin by 11%. It increased the percentage of monocytes by 50%, and increased lymphocyte and eosinophil percentages slightly. It caused slight elevations in blood zinc, magnesium, haemoglobin, and packed cell volume in the study subjects.<sup>32</sup> Yet another study indicated that routinely measured haematological parameters were also associated with insulin resistance and incident type 2 diabetes.<sup>33-36</sup>

In the present study, a remarkable improvement in PCV ( $p < 0.01$ ) was seen in prediabetic group and MCV and MCHC was significantly ( $p < 0.05$ ) improved in subjects of non-diabetic group. Results of a Californian study were in accordance with our findings indicating that human subjects administered with two honey treatments showed that honey eaters have the benefit of haematoprotection in addition to blood proliferation.<sup>37</sup> Honey has been reported to be beneficial to people suffering from anaemia.<sup>38</sup> Another Study, also documented enhanced hematology and immune response in rats fed 10% honeydew honey supplemented diet<sup>39</sup> Respectively research concluded that haematological indices could be utile indicators of vascular complication and glycaemic control in type 2 DM patients. Thus, they are important for the evaluation and early management of patients with pre diabetes.<sup>40</sup>

### Limitations

The present study was conducted on a small sample. There is a need for a larger randomized clinical trial to evaluate the effects of honey as a complementary therapy in prediabetic subjects in comparison with the non-diabetic subjects.

### Conclusion

In conclusion it was found Arhar honey administration significantly improved Hb, RBC and PCV in subjects with impaired glucose tolerance. Therefore, honey may prove to be a complementary therapy in amelioration of haematological parameters in prediabetic state.

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### References

1. Osei K, Rhines S, Gaillard T, Schuster D. Impaired insulin sensitivity, insulin secretion, and

glucose effectiveness predict future development of impaired glucose tolerance and type 2 diabetes in pre-diabetic African American. *Diab Care*. 2004; 27:1439-46.

2. Weyer C, Tatarani PA, Bogardus C, Pratley RE. Insulin resistance and insulin secretory dysfunction are independent predictors of worsening of glucose tolerance during each stage of type 2 diabetes development. *Diab Care*. 2000; 24:89-94
3. Rastogi S, Pandey N, Sachdev K. Linking Prameha etiology with diabetes mellitus: Inferences from a matched case-control study. *Ayu*. 2018 Jul-Sep;39(3):139-145. doi: 10.4103/ayu.AYU\_106\_18.
4. Rastogi S, Singh N, Gutch M, Bhattacharya A. Predicting and preventing diabetes: Translational potential of Ayurveda information on pre-diabetes. *J Ayurveda Integr Med*. 2021 Jul 15:S0975-9476(21)00099-1. doi: 10.1016/j.jaim.2021.05.009.
5. Wild S, Roglic G, Green A, Sicree R, King H: Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 27:1047–1053, 2004 Abstract/FREE Full Text Google Scholar
6. Knowler WC, Hamman RF, Edelstein SL, Barrett-Connor E, Ehrmann DA, Walker EA, Fowler SE, Nathan DM, Kahn SE. Prevention of type 2 diabetes with troglitazone in the diabetes prevention program. *Diabetes* 54:1150–1156, 2005
7. American Diabetes Association. Standard of medical care in diabetes. *Diab Care*. 2004; 27:S15-S35.
8. Nathan DM, Davidson BM, De Fronzo RA, Haine RJ, Henry RR, Pratly R, Zinman B. American Diabetes Association: Impaired fasting glucose and impaired glucose tolerance: implication for care. *Diab Care*. 2007; 30:753-9

9. Aroda VA, Ratner R A. To the patient with prediabetes. *J Clin Endocrinol Metab* 2008; 93(9):3259–65
10. Fonseca V. Identification and Treatment of Prediabetes To Prevent Progression To Type 2 Diabetes. *Clinical Cornerstone: The Best Of Clinical Cornerstone* 2007; 9(2): 51-61.
11. Ziaee A, Ghorbani A, Kalbasi S, Hejrati A, Moradi S. Association of hematological indices with prediabetes: A cross-sectional study. *Electronic Physician*. 2017;9(9):5206–11.
12. Twig G, Afek A, Shamiss A, Derazne E, Tzur D, Gordon B, Tirosh A. White blood cells count and incidence of type 2 diabetes in young men. *Diabetes Care*. 2013;36:276–282.
13. Jiang H, Yan WH, Li CJ, Wang AP, Dou JT, Mu YM. Elevated white blood cell count is associated with higher risk of glucose metabolism disorders in middle-aged and elderly Chinese people. *Int J Environ Res Public Health*. 2014;11:5497–5509
14. Vozarova B, Weyer C, Lindsay RS, Pratley RE, Bogardus C, Tataranni PA. High white blood cell count is associated with a worsening of insulin sensitivity and predicts the development of type 2 diabetes. *Diabetes*. 2002; 51:455–461.
15. Ozder A, Eker HH. Investigation of mean platelet volume in patients with type 2 diabetes mellitus and in subjects with impaired fasting glucose: a cost-effective tool in primary health care? *Int J ClinExp Med*. 2014;7:2292–2297. children? Platelets. 2014; 25:393–398
16. Subramani, S. K., Yadav, D., Mishra, M., Pakkirisamy, U., Mathiyalagen, P., & Prasad, G. B. K. S. (2019). Prevalence of type 2 diabetes and prediabetes in the gwalior-chambal region of central India. *Int J Environ Res Public Health* 2019; 16: (23).
17. Rana, S., Sharma, S., Katare, C., & Shrivatava, V. Glycemic Response and Glycemic Index of Common Sweeteners and Honey Incorporated Products. *IOSR Journal of Nursing and health Science*, (2012) 1(1), 40-44.
18. Raabo E, Terkildsen TC. On the enzymatic determination of blood glucose. *Scandinavian Journal of Clinical and Laboratory Investigation* 1960; 12(4): 402 407.
19. Nayak SS, Pattabiraman TN. A new colorimetric method for the estimation of glycosylated haemoglobin. *International Journal of Clinical Chemistry*. 1981; 109(3): 267 274.
20. Ranade VG, Joshi PN, Pradhan S. Hemoglobin estimation by the sahli's method. *A text book of practical physiology 3<sup>rd</sup> Edition*, PVG. Prakashan Pune 30, 1982; 294 298.
21. Mukharjee KL. A procedure manual for routine diagnostic tests, *Medical Laboratory Technology*, Volume-I, 15<sup>th</sup> reprint 2004;237 259.
22. Khan, R. M. M., Chua, Z. J. Y., Tan, J. C., Yang, Y., Liao, Z., & Zhao, Y. "From Pre-Diabetes to Diabetes: Diagnosis, Treatments and Translational Research." *Med* 2019; 55(9):1-30.
23. Liu, Dongying MM; Wen, Qing MM; Liu, Min MM; Gao, Yang MD; Luo, Lihong MM; Zhang, Zhuo MM; Chen, Qiu. Dietary supplements for prediabetes A protocol for a systematic review and meta-analysis *Medicine*: 2020; 99 (20) p e20347.
24. Agrawal OP, Pachauri A, Yadav H, Urmila J, Goswamy HM, Chapperwal A, Bisen PS, Prasad GBKS. Subjects with impaired glucose tolerance exhibit high degree of tolerance to honey. *Journal of Medicinal Food* 2007; 10(3): 473 478.
25. Bogdanov S, Jurendic T, Sieber R, Gallmann P. Honey for nutrition and health: a review. *Journal*

- of the American College of Nutrition 2008; 27(6): 677–689.
26. Mayes PA. Intermediary metabolism of fructose. *American Journal of Clinical Nutrition* 1993; 58(5 Suppl): 754S 765S.
27. Watford M. Small amounts of dietary fructose dramatically increase hepatic glucose uptake through a novel mechanism of glucokinase activation. *Nutrition Reviews* 2002; 60(8): 253 257.
28. Grodsky GM, Rafts AA, Bennett LL, Vcella C, Mcwilliams NB, Smith DF. Effects of carbohydrates on secretion of insulin from isolated rat pancreas. *The American Journal of Physiology* 1963; 205: 638 644.
29. Bae, JiCheol et al. “Hemoglobin A1c values are affected by hemoglobin level and gender in non-anemic Koreans.” *Journal of diabetes investigation* vol. 5,1 (2014): 60-5. doi:10.1111/jdi.12123
30. Meisinger C, Rückert IM, Stöckl D, Thorand B, Peters A, et al. Hematological Parameters and Prediabetes and Diabetes in Adults from the General Population: A Cross-Sectional Study. *J Diabetes Metab* 2014; 5: 335
31. Watford M. Small amounts of dietary fructose dramatically increase hepatic glucose uptake through a novel mechanism of glucokinase activation. *Nutrition Reviews* 2002; 60(8): 253 257.
32. Noori S Al-Waili. Effects of daily consumption of honey solution on haematological indices and blood levels of minerals and enzymes in normal individuals. *Journal of Medicinal Food* 2003; 6(2): 135 140.
33. Bi Y, Wang T, Xu M, Xu Y, Li M, et al. Advanced research on risk factors of type 2 diabetes. *Diabetes Metab Res Rev* 2012;28: 32-39.
34. Medalie JH, Papier CM, Goldbourt U, Herman JB. Major factors in the development of diabetes mellitus in 10,000 men. *Arch Intern Med* 1975; 135: 811-817.
35. Wilson PW, McGee DL, Kannel WB. Obesity, very low density lipoproteins, and glucose intolerance over fourteen years: The Framingham Study. *Am J Epidemiol* 1981; 114: 697-704.
36. Nakanishi N, Suzuki K, Tatarak. Haematocrit and risk of development of Type 2 diabetes mellitus in middle-aged Japanese men. *Diabet Med* 2004; 21: 476-482.
37. Schramm DD, Karim M, Schrader HR, Holt RR, Cardetti M, Keen CL. Honey with high levels of antioxidants can provide protection to healthy human subjects. *Journal of Agriculture and Food Chemistry* 2003; 51(6): 1732–1735.
38. Ajibola A, Idowu GO, Amballi AA, Oyefuga OH, Iquot IS: Improvement of some haematological parameters in albino rats with pure natural honey. *Research Journal of Biological Sciences* 2007; 2:67 69. .
39. Chepulis LM. The effect of honey compared to sucrose, mixed sugars and a sugar-free diet on weight gain in young rats. *Journal of Food Science* 2007; 72(3): S224–229.
40. Ziaee A, Ghorbani A, Kalbasi S, Hejrati A, Moradi S. Association of hematological indices with prediabetes: A cross-sectional study. *Electronic Physician*. 2017;9(9):5206–11.

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