TESIS PENELITIAN

PENGARUH PEMBERIAN *STINGLESS BEE HONEY* DAN *ENDURANCE TRAINING* TERHADAP KADAR GULA DARAH, PENANDA PRO-INFLAMASI IL6 DAN TNF-ALPHA PADA OTOT SKELET TIKUS WISTAR

Diajukan untuk Memenuhi Sebagian dari Syarat Memperoleh Gelar Magister

Pendidikan Kepelatihan Olahraga

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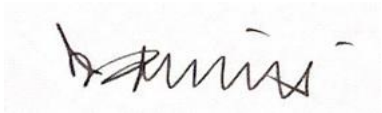

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Abstrak

Tujuan penelitian ini untuk mengetahui pengaruh pemberian *stingless bee honey* dan *endurance training* terhadap kadar gula darah, pro-inflamasi IL-6 dan TNF-α pada otot skelet tikus wistar. Metode penelitian adalah *True Eksperimental* dengan desain *The Randomize Posttest-Only Control Group Design*. Populasi pada penelitian ini adalah tikus wistar jantan, dengan Teknik sampling yang digunakan adalah *total sampling*. Instrumen yang digunakan dalam penelitian ini adalah *blood sampling (blood glucose autocheck)* untuk mengukur kadar gula darah, dan instrumen *western blot* untuk melihat ekspresi protein pro-inflamasi IL6 dan TNF-α. Hasil penelitian menunjukkan bahwa : (1) Tidak terdapat pengaruh yang signifikan dari pemberian *stingless bee honey* terhadap kadar gula darah. (2) Terdapat pengaruh yang signifikan dari pemberian *stingless bee honey* terhadap parameter pro-inflamasi. (3) Terdapat pengaruh yang signifikan dari *endurance training* terhadap kadar gula darah. (4) Terdapat pengaruh yang signifikan dari *endurance training* terhadap parameter pro-inflamasi IL-6 dan TNF–α. (5) Terdapat pengaruh yang signifikan dari pemberian stingless bee honey dan endurance training terhadap kadar gula darah. (6) Terdapat pengaruh yang signifikan dari pemberian *stingless bee honey* dan endurance training terhadap parameter pro-inflamasi IL-6 dan TNF-alpha.

Kata Kunci *: stingless bee honey, endurance training, inflamasi, blood glucose, tikus.*

Abstract

The aim of this study was to enhance the effects of stingless bee honey and endurance training on blood glucose, pro-inflammatory IL-6 and TNF-a in Wistar rats skeletal muscle. The research method used a True Experimental with The Randomize Posttest-Only Control Group Design. The population in this study were male Wistar rats, the sampling technique was used total sampling. The instruments are used blood sampling (blood glucose autocheck) to measure blood glucose levels, and western blot instruments to see the expression of pro-inflammatory proteins IL6 and TNF α. The results showed that: (1) There is no significant effect of giving stingless bee honey on blood sugar levels. (2) There is a significant effect of stingless bee honey on pro-inflammatory parameters. (3) There is a significant effect of endurance training on blood sugar levels. (4) There is a significant effect of endurance training on the pro-inflammatory parameters of IL-6 and TNF-a. (5) There is a significant effect of stingless bee honey and endurance training on blood sugar levels. (6) There is a significant effect of stingless bee honey and endurance training on pro-inflammatory parameters of IL-6 and TNF-a.

Keywords: stingless bee honey, endurance training, inflammation, blood glucose, rats.

DAFTAR ISI

DAFTAR PUSTAKA

Afrin, S., Gasparrini, M., Forbes-hernández, T. Y., Cianciosi, D., Reboredo-rodriguez, P., Pia, P., … Giampieri, F. (2018). Protective e ff ects of Manuka honey on LPS-treated RAW 264 . 7 macrophages . Part 1 : Enhancement of cellular viability , regulation of cellular apoptosis and improvement of mitochondrial functionality. *Food and Chemical Toxicology*, *121*(September), 203–213. https://doi.org/10.1016/j.fct.2018.09.001

Al-rahbi, B., Zakaria, R., Othman, Z., & Hassan, A. (2014). Acta Histochemica Tualang honey supplement improves memory performance and hippocampal morphology in stressed ovariectomized rats. *Acta Histochemica*, *116*(1), 79–88. https://doi.org/10.1016/j.acthis.2013.05.004

Al-waili, N. S. (2004). *Natural Honey Lowers Plasma Glucose, C-Reactive Protein, Homocysteine, and Blood Lipids in Healthy, Diabetic, and Hyperlipidemic Subjects: Comparison with Dextrose and Sucrose*. *7*(1), 100–107.

Albert, C. M. A., Ittelman, U. A. M., & Laudia U. (2000). *TRIGGERING OF SUDDEN DEATH FROM CARDIAC CAUSES BY VIGOROUS EXERTION*. 1355–1361.

Alvarez-suarez, J. M., Tulipani, S., Díaz, D., Estevez, Y., Romandini, S., Giampieri, F., … Battino, M. (2010). Antioxidant and antimicrobial capacity of several monofloral Cuban honeys and their correlation with color , polyphenol content and other chemical compounds. *Food and Chemical Toxicology*, *48*(8–9), 2490–2499. https://doi.org/10.1016/j.fct.2010.06.021

Anderson, C., & Galinsky, A. D. (2006). *Power , optimism , and risk-taking*. *536*(June 2004), 511–536.

Ayoub, S., Al-asiri, S. A., & Latief, A. (2017). Role of honey in modern medicine. *Saudi Journal of Biological Sciences*, *24*(5), 975–978. https://doi.org/10.1016/j.sjbs.2016.12.010

Beretta, G., Gelmini, F., Lodi, V., Piazzalunga, A., & Maffei, R. (2010). Journal of Pharmaceutical and Biomedical Analysis Profile of nitric oxide (NO) metabolites (nitrate , nitrite and N-nitroso groups) in honeys of different botanical origins : Nitrate accumulation as index of origin , quality and of therapeutic opportunities. *Journal of Pharmaceutical and Biomedical Analysis*, *53*(3), 343–349. https://doi.org/10.1016/j.jpba.2010.04.010

Beretta, G., Granata, P., Ferrero, M., Orioli, M., & Maffei, R. (2005). *Standardization of antioxidant properties of honey by a combination of spectrophotometric / fluorimetric assays and chemometrics*. *533*, 185–191. https://doi.org/10.1016/j.aca.2004.11.010

Beretta, G., Orioli, M., & Facino, R. M. (2007). *Antioxidant and Radical Scavenging Activity of Honey in Endothelial Cell Cultures (EA . hy926)*. https://doi.org/10.1055/s-2007-981598

Bernecker, C., Scherr, J., Schinner, S., Braun, S., Scherbaum, W. A., & Halle, M. (2011). *Evidence for an exercise induced increase of TNF- a and IL-6 in marathon runners*. 1–8. https://doi.org/10.1111/j.1600-0838.2011.01372.x

Betters, J. L., Criswell, D. S., Shanely, R. A., Gammeren, D. Van, Falk, D.,

Deruisseau, K. C., … Powers, S. K. (2004). *Trolox Attenuates Mechanical Ventilation – induced Diaphragmatic Dysfunction and Proteolysis*. *170*, 1179–1184. https://doi.org/10.1164/rccm.200407-939OC

Biluca, F. C., Betta, F. Della, Oliveira, G. P. De, Pereira, L. M., Gonzaga, L. V., Carolina, A., … Fett, R. (2014). *5-HMF and carbohydrates content in stingless bee honey by CE before and after thermal treatment*. *159*, 244–249. https://doi.org/10.1016/j.foodchem.2014.03.016

Bobi, O., Dezmirean, D. S., & Moise, A. R. (2018). *Review Article Honey and Diabetes : The Importance of Natural Simple Sugars in Diet for Preventing and Treating Different Type of Diabetes*. *2018*.

Bogdanov, S., Jurendic, T., Sieber, R., Gallmann, P., Bogdanov, S., Jurendic, T., … Gallmann, P. (2013). *Journal of the American College of Nutrition Honey for Nutrition and Health : A Review Honey for Nutrition and Health : A Review*. (September), 37–41. https://doi.org/10.1080/07315724.2008.10719745

Bowtell, J. L., Gelly, K., Jackman, M. L., Patel, A., Simeoni, M., & Rennie, M. J. (2018). *Effect of different carbohydrate drinks on whole body carbohydrate storage after exhaustive exercise*. 1529–1536.

Bradley, S. J., Kingwell, B. A., & Mcconell, G. K. (1999). *Nitric Oxide Synthase Inhibition Reduces Leg Glucose Uptake but not Blood Flow During Dynamic Exercise in Humans*. (24), 1815–1821.

Cai, B., Deitch, E. A., & Ulloa, L. (2010). *Novel Insights for Systemic Inflammation*

in Sepsis and Hemorrhage. *2010*. https://doi.org/10.1155/2010/642462

Carfagno, D. G., & Hendrix, J. C. (2014). *Overtraining Syndrome in the Athlete : Current Clinical Practice*. 45–51.

Chen, L., Deng, H., Cui, H., Fang, J., & Zuo, Z. (2018). *Inflammatory responses and inflammation-associated diseases in organs*. *9*(6), 7204–7218.

Cheuvront, S. N., Iii, R. C., Montain, S. J., Stephenson, L. A., & Ã, M. N. S. (2004). *Influence of hydration and airflow on thermoregulatory control in the heat*. *29*, 471–477. https://doi.org/10.1016/j.jtherbio.2004.08.016

Chun, S., Jee, S. Y., Lee, S. G., Park, S. J., & Lee, J. R. (2007). *Anti-Inflammatory Activity of the Methanol Extract of Moutan Cortex in LPS-Activated Raw264 . 7 Cells*. *4*(December 2006), 327–333. https://doi.org/10.1093/ecam/nel093

Chuttong, B., Chanbang, Y., & Sringarm, K. (2016). Effects of long term storage on stingless bee (Hymenoptera : Apidae : Meliponini) honey. *Journal of Apicultural Research*, *8839*, 1–10. https://doi.org/10.1080/00218839.2016.1186404

Chuttong, B., Chanbang, Y., Sringarm, K., & Burgett, M. (2016). Physicochemical profiles of stingless bee (Apidae : Meliponini) honey from South East Asia (Thailand). *FOOD CHEMISTRY*, *192*, 149–155. https://doi.org/10.1016/j.foodchem.2015.06.089

Cobley, J. N., Mchardy, H., Morton, J. P., Nikolaidis, M. G., & Close, G. L. (2015). *Free Radical Biology and Medicine In fl uence of vitamin C and vitamin E on redox signaling : Implications for exercise adaptations*. *84*, 65–76.

https://doi.org/10.1016/j.freeradbiomed.2015.03.018

Coyle, E. F., Coggan, R., A., Hemmert, M. K., Ivy, & L, J. (1986). *Muscle glycogen utilization during prolonged strenuous exercise when fed carbohydrate*. (7).

Dewanjee, S., Dua, T. K., & Sahu, R. (2013). Potential anti-Inflammatory effect of Leea macrophylla Roxb. leaves: a wild edible plant. *FOOD AND CHEMICAL TOXICOLOGY*. https://doi.org/10.1016/j.fct.2013.06.038

Dinarello. (2000). impact of basic research on tomorrow ' s Proinflammatory Cytokines *. *CHEST*, *118*(2), 503–508. https://doi.org/10.1378/chest.118.2.503

Dr. Owen Cronin. (2017). *The effect of exercise interventions on inflammatory biomarkers in healthy, physically inactive subjects: a systematic review*.

Elliott, S. S., Keim, N. L., Stern, J. S., Teff, K., & Havel, P. J. (2018). *Fructose , weight gain , and the insulin resistance syndrome 1 – 3*. (February).

Feghali-bostwick, C. A. (1997). *Cytokines acute and chronic inflammation*. (February 1997). https://doi.org/10.2741/A171

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2013). BİBLİYOGRAFİSİ Bulunacak. In *Climate Change 2013 - The Physical Science Basis* (Vol. 53). https://doi.org/10.1017/CBO9781107415324.004

Gabay, C. (2006). *Interleukin-6 and chronic inflammation*. *6*, 1–6. https://doi.org/10.1186/ar1917

Galhardi, F., Mesquita, K., Monserrat, J. M., & Barros, D. M. (2009). Effect of silymarin on biochemical parameters of oxidative stress in aged and young rat

brain. *Food and Chemical Toxicology*, *47*(10), 2655–2660. https://doi.org/10.1016/j.fct.2009.07.030

Ghosh, S., & Playford, R. J. (2003). *Bioactive natural compounds for the treatment of gastrointestinal disorders*. (March 2016). https://doi.org/10.1042/CS20030067

Gomez-cabrera, M. C., Domenech, E. C., Ji, L. L., & Viña, J. (2006). *Exercise as an antioxidant : it up-regulates important enzymes for cell adaptations to exercise Effet anti-oxydant de l ' exercice : up-régulation d ' enzymes clés de l ' adaptation cellulaire à l ' exercice*. *21*, 85–89. https://doi.org/10.1016/j.scispo.2005.06.012

Guerrini, A., Bruni, R., Maietti, S., Poli, F., Rossi, D., Paganetto, G., … Sacchetti, G. (2009). Ecuadorian stingless bee (Meliponinae) honey : A chemical and functional profile of an ancient health product. *Food Chemistry*, *114*(4), 1413–1420. https://doi.org/10.1016/j.foodchem.2008.11.023

Haman, F., GlenP.Kenny, Weber, J.-M., P´eronnet, F., Massicotte, D., & Lavoie, C. (2005). *Partitioning oxidative fuels during cold exposure in humans : muscle glycogen becomes dominant as shivering*. *1*, 247–256. https://doi.org/10.1113/jphysiol.2005.086272

Hayashi, T., Wojtaszewski, J. F. P., & Goodyear, A. L. J. (1997). *invited review*.

Hilsted, J., Holst, J. J., Christensen, N. J., & Nielsen, L. (1991). *glucagon and glucose recovery after hypoglycemia : The effect of total autonomic blockade*.

Himaya, S. W. A., Ryu, B., Qian, Z., Li, Y., & Kim, S. (2011). 1-(5-bromo-2-

hydroxy-4-methoxyphenyl)ethanone [SE1] suppresses pro-inflammatory responses by blocking NF-κB and MAPK signaling pathways in activated microglia. *European Journal of Pharmacology*, *670*(2–3), 608–616. https://doi.org/10.1016/j.ejphar.2011.09.013

Huang, M., Huang, S., Wang, B., Wu, C., Sheu, M., Hou, W., … Huang, G. (2011). Antioxidant and anti-inflammatory properties of Cardiospermum halicacabum and its reference compounds ex vivo and in vivo. *Journal of Ethnopharmacology*, *133*(2), 743–750. https://doi.org/10.1016/j.jep.2010.11.005

Huh, J. Y. (2017). The role of exercise-induced myokines in regulating metabolism. *Archives of Pharmacal Research*. https://doi.org/10.1007/s12272-017-0994-y

Hussein, S. Z., Yusoff, K. M., Makpol, S., Anum, Y., & Yusof, M. (2012). *Gelam Honey Inhibits the Production of Proinflammatory , Mediators NO , PGE 2 , TNF- α , and IL-6 in Carrageenan-Induced Acute Paw Edema in Rats*. *2012*. https://doi.org/10.1155/2012/109636

Hussein, S. Z., Yusoff, K. M., Makpol, S., Anum, Y., & Yusof, M. (2013). *Gelam Honey Attenuates Carrageenan-Induced Rat Paw Inflammation via NF- k B Pathway*. *8*(8). https://doi.org/10.1371/journal.pone.0072365

Ivy. (1998). *Glycogen Resynthesis After Exercise: Effect of Carbohydrate Intake*. (3), 3–6.

Jentjens, R. L. P. G., Achten, J., & Jeukendrup, A. E. (2004). *High Oxidation Rates from Combined Carbohydrates Ingested during Exercise*. *36*, 1551–1558.

https://doi.org/10.1249/01.MSS.0000139796.07843.1D

Jeukendrup, A. E. (2004). *Carbohydrate Intake During Exercise and Performance*. https://doi.org/10.1016/j.nut.2004.04.017

Jeukendrup, A. E. (2011). *Nutrition for endurance sports : Marathon , triathlon , and road cycling*. *0414*. https://doi.org/10.1080/02640414.2011.610348

Kapilevich, L. V, Zakharova, A. N., Kabachkova, A. V, Kironenko, T. A., & Orlov, S. N. (2017). *Dynamic and Static Exercises Differentially Affect Plasma Cytokine Content in Elite Endurance- and Strength-Trained Athletes and Untrained Volunteers*. *8*(January), 1–10. https://doi.org/10.3389/fphys.2017.00035

Kerasioti, E., Kiskini, A., Veskoukis, A., Jamurtas, A., Tsitsimpikou, C., Tsatsakis, A. M., … Karathanos, V. (2012). Effect of a special carbohydrate – protein cake on oxidative stress markers after exhaustive cycling in humans. *Food and Chemical Toxicology*, *50*(8), 2805–2810. https://doi.org/10.1016/j.fct.2012.04.015

Khalil, M. I., Sulaiman, S. A., & Boukraa, L. (2010). *Antioxidant Properties of Honey and Its Role in Preventing Health Disorder*. 6–16.

Kharraz, Y., Guerra, J., Mann, C. J., Serrano, A. L., & Muñoz-cánoves, P. (2013). *Macrophage Plasticity and the Role of In ?a ??ation in Skeletal Muscle Repair*. *2013*.

Krishnadas, R., & Cavanagh, J. (2012). *Depression : an inflammatory illness ?* 495–502. https://doi.org/10.1136/jnnp-2011-301779

Kuipers, B., & Keizer, B. A. (1988). *Review and Directions for the Future Overtraining in Elite Athletes*. *92*, 79–92.

Kumar, S., & Pandey, A. K. (2013). *Chemistry and Biological Activities of Flavonoids : An Overview*. *2013*.

Larrosa, M., Luceri, C., Vivoli, E., Pagliuca, C., & Lodovici, M. (2009). *Polyphenol metabolites from colonic microbiota exert anti-inflammatory activity on different inflammation models*. 1044–1054. https://doi.org/10.1002/mnfr.200800446

Lavratti, C., Dorneles, G., Pochmann, D., Peres, A., Bard, A., Schipper, L. de L., … Luciane Carniel Wagner. (2016). Exercise-induced modulation of histone H4 acetylation status and cytokines levels in patients with SZ. *Physiology & Behavior*. https://doi.org/10.1016/j.physbeh.2016.10.021

Li, Y., Yeh, C., Yang, M., & Kuan, Y. (2012). *Luteolin Suppresses Inflammatory Mediator Expression by Blocking the Akt / NF κ B Pathway in Acute Lung Injury Induced by Lipopolysaccharide in Mice*. *2012*. https://doi.org/10.1155/2012/383608

Liu, J., Ye, Y., Lin, T., Wang, Y., & Peng, C. (2013). Effect of floral sources on the antioxidant , antimicrobial , and anti-inflammatory activities of honeys in Taiwan. *Food Chemistry*, *139*(1–4), 938–943. https://doi.org/10.1016/j.foodchem.2013.02.015

Margonis, K., Fatouros, I. G., & Jamurtas, A. Z. (2007). *Oxidative stress biomarkers responses to physical overtraining : Implications for diagnosis*.

43, 901–910. https://doi.org/10.1016/j.freeradbiomed.2007.05.022

Mayes, A. (2018). *metabolism of fructose3*. (March), 754–765.

Meldrum, D. R., Cleveland, J. C., Cain, B. S., Meng, X., & Harken, A. H. (1998). *Increased Myocardial Tumor Necrosis Factor- ⎵ in a Crystalloid-Perfused Model of Cardiac Ischemia- Reperfusion Injury*. *4975*(97).

Memon, M. Q., & Kumar, A. (2007). *MINI-REVIEW The Fructose mystery : How bad or good is it ?* 1241–1245.

Meo, S. A., Ansari, M. J., Sattar, K., Habib, C., Hajjar, W., & Alasiri, S. (2016). Honey and Diabetes Mellitus: Obstacles and Challenges - Road to be Repaired. *Saudi Journal of Biological Sciences*, (2017). https://doi.org/10.1016/j.sjbs.2016.12.020

Monteiro-junior, R. S., Estadual, U., Claros, D. M., Maciel-pinheiro, P. D. T., Fluminense, U. F., & Matta, E. (2017). *Effect of Exercise on Inflammatory Profile of Older Persons: Systematic Review and Meta-Analyses*. (February 2018). https://doi.org/10.1123/jpah.2016-0735

Mothana, R. A. A. (2011). Anti-inflammatory , antinociceptive and antioxidant activities of the endemic Soqotraen Boswellia elongata Balf . f . and Jatropha unicostata Balf . f . in different experimental models. *Food and Chemical Toxicology*, *49*(10), 2594–2599. https://doi.org/10.1016/j.fct.2011.06.079

Nathan, C. (2002). *Points of control in inflammation*. *420*(December).

Nayik, G. A., Suhag, Y., Majid, I., & Nanda, V. (2016). Discrimination of high altitude Indian honey by chemometric approach according to their antioxidant

properties and macro minerals. *JOURNAL OF THE SAUDI SOCIETY OF AGRICULTURAL SCIENCES*. https://doi.org/10.1016/j.jssas.2016.04.004

Nikolaidis, M. G., Kyparos, A., Hadziioannou, M., Panou, N., Samaras, L., Jamurtas, A. Z., & Kouretas, D. (2007). *Acute exercise markedly increases blood oxidative stress in boys and girls*. *205*, 197–205. https://doi.org/10.1139/H06-097

Ostrowski, K., Rohde, T., Asp, S., Schjerling, P., & Pedersen, B. K. (1999). *Pro- and anti-inflammatory cytokine balance in strenuous exercise in humans*. *6*, 287–291.

Othman, N. H. (2012). *Honey and Cancer : Sustainable Inverse Relationship Particularly for Developing Nations — A Review*. *2012*(Figure 2). https://doi.org/10.1155/2012/410406

Özbalci, B., Boyaci, ismail hakki, Topcu, A., Kadilar, C., & Tamer, U. (2013). *Rapid analysis of sugars in honey by processing Raman spectrum using chemometric methods and artificial neural networks*. *136*, 1444–1452. https://doi.org/10.1016/j.foodchem.2012.09.064

Peng, S., Ling, N., Aniza, Y., Wei, S., & Suan, L. (2014). Total Phenolic Contents and Colour Intensity of Malaysian Honeys from the Apis spp . and Trigona spp . Bees. *Italian Oral Surgery*, *2*, 150–155. https://doi.org/10.1016/j.aaspro.2014.11.022

Philippe, M., Pj, K., Mersa, L., Em, E., Gatterer, H., Melmer, A., … Burtscher, M. (2016). *Acute effects of concentric and eccentric exercise on glucose*

metabolism and interleukin-6 concentration in healthy males. 153–158. https://doi.org/10.5604/20831862.1198634

POTTER, K. M. H. A. G. D. (1996). *A REVIEW OF RECENT RESEARCH ON*. (1996), 149–173.

Prudente, A. S., Luz, C. F. P., Maia, B. H. L. N. S., Cabrini, D. A., Otuki, M. F., Miguel, M. D., … Miguel, O. G. (2014). *Topical Anti-Inflammatory Activity of a Monofloral Honey of Mimosa scabrella Provided by Melipona marginata During Winter in Southern Brazil 1 ´*. *17*(7), 817–825. https://doi.org/10.1089/jmf.2013.0024

Pruimboom, L., Raison, C. L., & Muskiet, F. A. J. (2015). *Physical Activity Protects the Human Brain against Metabolic Stress Induced by a Postprandial and Chronic Inflammation*. *2015*.

Punchard, N. A., Whelan, C. J., & Adcock, I. (2004). *Journal of Inflammation*. *4*, 1–4. https://doi.org/10.1186/1476-9255-1-1

Ranneh, Y., Akim, A., Hamid, H. A., Khazaai, H., Fadel, A., & Mahmoud, A. M. (2019). *Stingless bee honey protects against lipopolysaccharide induced-chronic subclinical systemic inflammation and oxidative stress by modulating Nrf2 , NF- κ B and p38 MAPK*. 1–17.

Rao, P. V., Salleh, N., & Gan, S. H. (2016). Biological and therapeutic effects of honey produced by honey bees and stingless bees: a comparative review. *Revista Brasileira de Farmacognosia*, 1–8. https://doi.org/10.1016/j.bjp.2016.01.012

Rashid, M. R., Nain, K., Aripin, N., Begum, F., Mohideen, S., Baharom, N., … Addnan, F. H. (2019). *The Effect of Kelulut Honey on Fasting Blood Glucose and Metabolic Parameters in Patients with Impaired Fasting Glucose*. *2019*.

Rosset, R., Egli, L., & Lecoultre, V. (2017). *Glucose – fructose ingestion and exercise performance : The gastrointestinal tract and beyond*. *1391*(April). https://doi.org/10.1080/17461391.2017.1317035

Sabir, A., Tabbu, C. R., Agustiono, P., & Sosroseno, W. (2005). *Histological analysis of rat dental pulp tissue capped with propolis*. *47*(3), 135–138.

Sabry, E., & Shalaby, M. N. (2010). *Effect of a Nutrition Compound (Honey and Water) on Blood Glucose , Body Temperature and Some Physiological Variables in Wrestlers Effect of a Nutrition Compound (Honey and Water) on Blood Glucose , Body Temperature and Some Physiological Variables in Wrestlers*. (January).

Sahlan, M., Rahmawati, O., Kartika, D., & Raffiudin, R. (2019). Effects of stingless bee (Tetragonula biroi) honey on streptozotocin-induced diabetes mellitus in rats < !– Effects of stingless bee (Tetragonula biroi) honey on streptozotocin-induced diabetes mellitus in rats. *Saudi Journal of Biological Sciences*. https://doi.org/10.1016/j.sjbs.2019.11.039

Saleem, U., Ahmad, B., Ahmad, M., Hussain, K., & Bukhari, N. I. (2015). Asian Pacific Journal of Tropical Disease. *Asian Pacific Journal of Tropical Disease*, *5*(4), 322–328. https://doi.org/10.1016/S2222-1808(14)60791-X

Scislowski, V., Lac, G., Durand, D., Vidalin, H., & Robert, A. (n.d.). *Antioxidant*

Status and Oxidative Stress in Professional Rugby Players : Evolution Throughout a Season. https://doi.org/10.1055/s-2005-837489

Shah, P. K., & Angeles, L. (1998). *Role of inflammation and metalloproteinases in plaque disruption and thrombosis*. https://doi.org/10.1191/135886398676959944

Shakir, M., Aziz, A., Giribabu, N., Visweswara, P., & Salleh, N. (2017). Pancreatoprotective effects of Geniotrigona thoracica stingless bee honey in streptozotocin-nicotinamide-induced male diabetic rats. *Biomedicine et Pharmacotherapy*, *89*, 135–145. https://doi.org/10.1016/j.biopha.2017.02.026

Sirajudeen, K. N. S., Salleh, M. S., & Gurtu, S. (2010). Antioxidant protection of Malaysian tualang honey in pancreas of normal and streptozotocin-induced diabetic rats. *Annales d'Endocrinologie*, *71*(4), 291–296. https://doi.org/10.1016/j.ando.2010.03.003

Souza, B., Roubik, D., Barth, O., Heard, T., Enríquez, E., Carvalho, C., … Vit, P. (2006). *COMPOSITION OF STINGLESS BEE HONEY : SETTING QUALITY STANDARDS*. *31*, 867–875.

St, B., Schneider, P., & Tiidus, P. M. (2007). *Neutrophil Infiltration in Exercise-Injured Skeletal Muscle How Do We Resolve the Controversy ? 37*(10), 837–856.

Tappy, L. (2019). *Health outcomes of a high fructose intake : the importance of physical activity*. *14*(September 2018), 3561–3571. https://doi.org/10.1113/JP278246

Taylor, P. (2018). *Botanical characterisation of Mexican honeys from a subtropical region (Oaxaca) based on pollen analysis This article was downloaded by : [Conacyt Consortia / SWETS Information Services] Access details : Access Details : [subscription number 934426523] Grana Botanical characterisation of Mexican honeys from a subtropical region (Oaxaca) based on pollen analysis*. (March 2011). https://doi.org/10.1080/00173134.2010.537767

Thompson, P. D., Buchner, D., Piña, I. L., Balady, G. J., Williams, M. A., Bess, H., … Rodriguez, B. L. (2003). *Exercise and Physical Activity in the Prevention and Treatment of Atherosclerotic Cardiovascular Disease A Statement From the Council on Clinical Cardiology (Subcommittee on Definition of Terms*. https://doi.org/10.1161/01.CIR.0000075572.40158.77

Tidball, J. G., & Villalta, S. A. (2010). *Regulatory interactions between muscle and the immune system during muscle regeneration*. *2*. https://doi.org/10.1152/ajpregu.00735.2009.

Tonks, A. J., Dudley, E., Porter, N. G., Parton, J., Brazier, J., Smith, E. L., & Tonks, A. (2007). *A 5 . 8-kDa component of manuka honey stimulates immune cells via TLR4 Abstract : Honey is used as a therapy to aid wound healing . Previous data indicate that honey can stim-*. *82*(November), 1147–1155. https://doi.org/10.1189/jlb.1106683

Tshwane, L. L. S. (2004). *TISSUE TRAUMA:THE UNDERLYING CAUSE OF OVERTRAINING SYNDROME? 18*(1), 185–193.

Tsintzas, O., Williams, C., Boobis, L., & Greenhaff, P. (1995). *Carbohydrate ingestion and glycogen utilization in different muscle fibre types in man*. 243–250.

Tuksitha, L., Chen, Y. S., Chen, Y., Wong, K., & Peng, C. (2018). Journal of Asia-Paci fi c Entomology Antioxidant and antibacterial capacity of stingless bee honey from Borneo (Sarawak). *Journal of Asia-Pacific Entomology*, *21*(2), 563–570. https://doi.org/10.1016/j.aspen.2018.03.007

Turkmen, N., Sari, F., Poyrazoglu, E. S., & Velioglu, Y. S. (2006). *Effects of prolonged heating on antioxidant activity and colour of honey*. *95*, 653–657. https://doi.org/10.1016/j.foodchem.2005.02.004

Vandenbogaerde, T. J., & Hopkins, W. G. (2011). *Effects of Acute Carbohydrate Supplementation on Endurance Performance*. *41*(9), 773–792.

Wallach, D., Varfolomeev, E. E., Malinin, N. L., Goltsev, Y. V, Kovalenko, A. V, & Boldin, M. P. (1999). *TUMOR NECROSIS FACTOR RECEPTOR AND Fas SIGNALING MECHANISMS*.

Wang, J., & Li, Q. X. (2011). Chemical Composition, Characterization, and Differentiation of Honey Botanical and Geographical Origins. In *Advances in Food and Nutrition Research* (1st ed., Vol. 62). https://doi.org/10.1016/B978-0-12-385989-1.00003-X

White, J. S. (2013). *Challenging the Fructose Hypothesis : New Perspectives on Fructose Consumption and*. 246–256. https://doi.org/10.3945/an.112.003137.caution

Yazan, L. S., Firdaus, M., Muhamad, S., Ali, R. M., Zainal, N. A., Esa, N., … Alwi, S. (2016). *Chemopreventive Properties and Toxicity of Kelulut Honey in Sprague Dawley Rats Induced with Azoxymethane*. *2016*.

Zainol, M. I., & Yusoff, K. M. (2013). *Antibacterial activity of selected Malaysian honey*.