BAB 5
KESIMPULAN DAN SARAN

5.1 Kesimpulan

Berdasarkan *literature review* yang dilakukan dan hasil analisis dari literatur yang diperoleh maka dapat ditarik kesimpulan:

1. Secara teoritis serat pangan dapat menurunkan kadar asam urat dalam darah melalui mekanisme peningkatan viskositas saluran pencernaan sehingga menurunkan penyerapan purin berlebihan yang berasal dari makanan serta dapat mempengaruhi enzim yang mensintesis asam urat yaitu *xanthine oxidase*.
2. Secara teoritis serat pangan dapat menurunkan kadar trigliserida melalui mekanisme peningkatan viskositas saluran pencernaan sehingga menurunkan penyerapan lemak berlebihan yang berasal dari makanan serta dapat mempengaruhi enzim yang mensintesis lemak yaitu *Fatty Acid Synthase*. MCT dapat menurunkan kadar trigliserida dengan mempengaruhi enzim yang berpengaruh dalam sintesis trigliserida yaitu *Acetyl-CoA Carboxylase* dan *Acyl-CoA Oxidase*.
3. Serat pangan dan MCT bekerja sinergis dalam menurunkan sintesis lemak sehingga mengkombinasikan keduanya dapat menurunkan kadar trigliserida dalam darah.

5.2 Saran

Tidak adanya penelitian mengenai efek lemak rantai sedang (MCT) terhadap kadar asam urat sehingga dirasa perlu dilakukan penelitian tentang efek lemak rantai sedang (MCT) terhadap kadar asam urat. Minimnya penelitian yang menggunakan sampel kombinasi serat pangan dan lemak rantai sedang (MCT) sehingga perlu dilakukan penelitian lebih lanjut mengenai kombinasi tersebut sehingga dapat mengamati interaksi keduanya dan dapat menentukan jenis serat mana yang paling cocok dikombinasikan dengan MCT.

DAFTAR PUSTAKA

Aitman, T. J., Glazier, A. M., Wallace, C. A., Cooper, L. D., Norsworthy, P. J., Wahid, F. N., Al-Majali, K. M., Trembling, P. M., Mann, C. J., Shoulders, C. C., Graf, D., St Lezin, E., Kurtz, T. W., Kren, V., Pravenec, M., Ibrahimi, A., Abumrad, N. A., Stanton, L. W., Scott, J. 1999, Identification of Cd36 (Fat) as an insulin-resistance gene causing defective fatty acid and glucose metabolism in hypertensive rats. *Nature Genetics,* **21**: 76–83.

Aitman, T. J., Gotoda, T., Evans, A. L., Imrie, H., Heath, K. E., Trembling, P. M., Truman, H., Wallace, C. A., Rahman, A., Doré, C., Flint, J., Kren, V., Zidek, V., Kurtz, T. W., Pravenec, M., Scott, J. 1997, Quantitative trait loci for cellular defects in glucose and fatty acid metabolism in hypertensive rats*, Nature Genetics,* **16**: 197–201.

Antonios, N., Angiolillo, D. J., Silliman, S. 2008, Hypertriglyceridemia and Ischemic Stroke, *European Neurology*, **60**: 269-278.

Bach, A. C., Babayan, V. K. 1982, Medium-chain triglycerides—An update, *American Journal of Clinical Nutrition*, **36**: 950–962.

Bays, H., Ballantyne, C. 2006, Adiposopathy: Why do adiposity and obesity cause metabolic disease, *Future Lipidol,* **1**: 389-420.

Benn, C. L., Dua, P., Gurrell, R., Loudon, P., Pike, A., Storer, R. I., Vangjeli, C. 2018, Physiology of Hyperuricemia and Urate-Lowering Treatment*, Frontiers in medicine*, **5**: 160.

Berglund, L., Brunzell, J. D., Goldberg, A. C., Goldberg, I. J., Sacks, F., Murad, M. H., Stalenhoef, A. F., Endocrine society. 2012, Evaluation and treatment of hypertriglyceridemia: an Endocrine Society clinical practice guideline, *The Journal of clinical endocrinology and metabolism*, **97(9)**: 2969–2989.

Boehm, O., Zur, B., Koch, A., Tran, N., Freyenhagen, R., Hartmann, M., Zacharowski, K. 2007, Clinical chemistry reference database for Wistar rats and C57/BL6 mice, Biological chemistry, **388(5)**: 547–554.

Bonnema, A. L., Kolberg, L. W., Thomas, W., Slavin, J. L. 2010, Gastrointestinal tolerance of chicory inulin products, *Journal of the American Dietetic Association*, **110(6)**, 865–868

Brucato, A., Cianci, F., Carnovale, C. 2020, Management of hyperuricemia in asymptomatic patients: A critical appraisal, *European Journal of Internal Medicine*, **74**: 8-17.

Chawla, R., Patil, G. 2010, Soluble Dietary Fiber, *Comprehensive Reviews in Food Science and Food Safety*, **9**: 178-196.

Chen, J. H., Yeh, W. T., Chuang, S. Y., Wu, Y. Y., Pan, W. H. 2012, Gender-specific risk factors for incident gout: a prospective cohort study, *Clinical rheumatology*, **31(2)**: 239–245.

Choi, H. K., Liu, S., Curhan, G. 2005, Intake of purine-rich foods, protein, and dairy products and relationship to serum levels of uric acid: the Third National Health and Nutrition Examination Survey*, Arthritis and rheumatism*, **52(1)**: 283–289.

DiPiro, J. T., Robert, L. Talbert, Gary, C. Yee, Gary, R., Matzke, Barbara, G. Wells, L., Posey, M. 2017, *Pharmacotherapy: A Pathophysiologic Approach, 10th edition,* New York: The McGraw-Hill Companies.

Eswaran, S., Muir, J., Chey, W. D. 2013, Fiber and functional gastrointestinal disorders, *The American journal of gastroenterology*, **108(5)**: 718–727.

Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. 2001, Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III), *Journal of the American Medical Association*, **285(19)**: 2486–2497.

Ferreira, M. L., Tonetto, G. M. 2017, *Enzymatic Synthesis of Structured Triglycerides: From Laboratory to Industry*, Switzerland: Springer International Publisher.

Firestein, G. S., Gabriel, S. E., McInnes, I. B., O'Dell, J. R. 2017, *Kelley and Firestein's textbook of rheumatology*, Philadelphia: Elsevier.

FAO/WHO *Codex Alimentarius Commission. 1995, Guidelines for Nutrition Labelling. Codex Alimentarius, Volume 1A*, *General Requirements*, Rome: FAO.

Forman, L. P., Schneeman, B. O. 1980, Effects of dietary pectin and fat on the small intestinal contents and exocrine pancreas of rats, *Journal of nutrition*, **110(10)**: 1992–1999.

Garbagnati, E. 1996, Urate changes in lean and obese boys during pubertal development, *Metabolism: clinical and experimental*, **45(2)**: 203–205.

Grabitske, H. A., Slavin, J. L. 2008, Low-digestible carbohydrates in practice, *Journal of the American Dietetic Association*, **108(10)**: 1677–1681.

Gralak, M. A., Leontowicz, M., Morawiec, M., Bartnikowska, E., Kulasek, G. W. 1996, Comparison of the influence of dietary fibre sources with different proportions of soluble and insoluble fibre on Ca, Mg, Fe, Zn, Mn and Cu apparent absorption in rats, *Archiv fur Tierernahrung*, **49(4)**: 293–299.

Greenberger, N. J., Rodgers, J. B., Isselbacher, K. J. 1966, Absorption of medium and long chain triglycerides: factors influencing their hydrolysis and transport, *Journal of clinical investigation*, **45(2)**: 217–227.

Gunness, P., Gidley, M. J. 2010, Mechanisms underlying the cholesterol-lowering properties of soluble dietary fibre polysaccharides, *Food & function*, **1(2)**: 149–155.

Guo, Y., Yu, Y., Li, H., Ding, X., Li, X., Jing, X., Chen, J., Liu, G., Lin, Y., Jiang, C., Liu, Z., He, Y., Li, C., Tian, Z. 2020, Inulin supplementation ameliorates hyperuricemia and modulates gut microbiota in Uox-knockout mice, *European journal of nutrition*, Advance online publication.

Hauenschild, A., Bretzel, R. G., Schnell-Kretschmer, H., Kloer, H. U., Hardt, P. D., Ewald, N. 2010, Successful treatment of severe hypertriglyceridemia with a formula diet rich in omega-3 fatty acids and medium-chain triglycerides, *Annals of nutrition & metabolism*, **56(3)**, 170–175.

Ho, K. S., Tan, C. Y., Mohd Daud, M. A., Seow-Choen, F. 2012, Stopping or reducing dietary fiber intake reduces constipation and its associated symptoms, *World journal of gastroenterology*, **18(33)**: 4593–4596.

Kanbay, M., Jensen, T., Solak, Y., Le, M., Roncal-Jimenez, C., Rivard, C., Lanaspa, M. A., Nakagawa, T., Johnson, R. J. 2016, Uric acid in metabolic syndrome: From an innocent bystander to a central player, *European journal of internal medicine*, **29**: 3–8.

Kapetanovic, M. C., Nilsson, P. M., Turesson, C., Dalbeth, N., Englund, M., Scheepers, L. E., Jacobsson, L. T. H. 2018, Predictors for clinically

diagnosed gout: 30 years follow-up in the Malmo Preventive Project cohort Sweden. *Scandinavian Journal of Rheumatology*, **47(129)**: 25–26.

Koguchi, T., Nakajima, H., Wada, M., Yamamoto, Y., Innami, S., Maekawa, A., Tadokor, T. 2002, Dietary fiber suppresses elevations of uric acid and allantoin in serum and urine induced by dietary RNA and increases its excretion to feces in rats, *Journal of nutritional science and vitaminology*, **48(3)**: 184–193.

Koguchi, T., Nakajima, H., Koguchi, H., Wada, M., Yamamoto, Y., Innami, S., Maekawa, A., Tadokoro, T. 2003, Suppressive effect of viscous dietary fiber on elevations of uric acid in serum and urine induced by dietary RNA in rats is associated with strength of viscosity, *International journal for vitamin and nutrition research*, **73(5)**: 369–376.

Koguchi, T., Koguchi, H., Nakajima, H., Takano, S., Yamamoto, Y., Innami, S., Maekawa, A., Tadokoro, T. 2004, Dietary fiber suppresses elevation of uric acid and urea nitrogen concentrations in serum of rats with renal dysfunction induced by dietary adenine, *International journal for vitamin and nutrition research*, **74(4)**: 253–263.

Lattimer, J., Haub, M. 2010, Effects of Dietary Fiber and Its Components on Metabolic Health, *Nutrients*, **2**: 1266-89.

Laufs, U., Parhofer, K. G., Ginsberg, H. N., Hegele, R. A. 2020, Clinical review on triglycerides, *European heart journal*, **41(1)**, 99–109c.

Lecumberri, E., Goya, L., Mateos, R., Alía, M., Ramos, S., Izquierdo-Pulido, M., Bravo, L. 2007, A diet rich in dietary fiber from cocoa improves lipid profile and reduces malondialdehyde in hypercholesterolemic rats, *Nutrition*, **23(4)**: 332–341.

Li, H., Liu, Y., Zhang, X., Xu, Q., Zhang, Y., Xue, C., Guo, C. 2018, Medium-chain fatty acids decrease serum cholesterol via reduction of intestinal bile acid reabsorption in C57BL/6J mice, *Nutrition and metabolism*, **15**: 37.

Lin, K., Lin, H., Chou, P. 2000, The interaction between uric acid level and other risk factors on the development of gout among asymptomatic hyperuricemic men in a prospective study, *Journal of Rheumatology*, **27(6)**: 1501–1505.

Lin, Z., Zhang, B., Liu, X., Jin, R., Zhu, W. 2014, Effects of chicory inulin on serum metabolites of uric acid, lipids, glucose, and abdominal fat deposition in quails induced by purine-rich diets, *Journal of medicinal food*, **17(11)**: 1214–1221.

Liu, J., Zeng, F. F., Liu, Z. M., Zhang, C. X., Ling, W. H., Chen, Y. M. 2013, Effects of blood triglycerides on cardiovascular and all-cause mortality: a systematic review and meta-analysis of 61 prospective studies, *Lipids in health and disease*, **12**: 159.

Lu, J., Hou, X., Yuan, X., Cui, L., Liu, Z., Li, X., Ma, L., Cheng, X., Xin, Y., Wang, C., Zhang, K., Wang, X., Ren, W., Sun, R., Jia, Z., Tian, Z., Mi, Q. S., Li, C. 2018, Knockout of the urate oxidase gene provides a stable mouse model of hyperuricemia associated with metabolic disorders, *Kidney international*, **93**(1): 69–80.

Maiuolo, J., Oppedisano, F., Gratteri, S., Muscoli, C., Mollace, V. 2016, Regulation of uric acid metabolism and excretion, *International Journal of Cardiology*, **213**: 8-14.

Maki, K. C., Mustad, V., Dicklin, M. R., Geohas, J. 2009, Postprandial metabolism with 1,3- diacylglycerol oil versus equivalent intakes of long-chain and medium-chain triacylglycerol oils, *Nutrition*, **25(6)**: 627–633.

Matsuura, F., Yamashita, S., Nakamura, T., Nishida, M., Nozaki, S., Funahashi, T., Matsuzawa, Y. 1998, Effect of visceral fat accumulation on uric acid metabolism in male obese subjects: visceral fat obesity is linked more closely to overproduction of uric acid than subcutaneous fat obesity, *Metabolism: clinical and experimental*, **47(8)**: 929–933.

Merriman, T. 2015, An update on the genetic architecture of hyperuricemia and gout, *Arthritis Research and Therapy*, **17**: 98.

Miller, M., Stone, N. J., Ballantyne, C., Bittner, V., Criqui, M. H., Ginsberg, H. N., Goldberg, A. C., Howard, W. J., Jacobson, M. S., Kris-Etherton, P. M., Lennie, T. A., Levi, M., Mazzone, T., Pennathur, S., American Heart Association Clinical Lipidology, Thrombosis, and Prevention Committee of the Council on Nutrition, Physical Activity, and Metabolism, Council on Arteriosclerosis, Thrombosis and Vascular Biology, Council on Cardiovascular Nursing, Council on the Kidney in Cardiovascular Disease. 2011, Triglycerides and

cardiovascular disease: a scientific statement from the American Heart Association, *Circulation*, **123(20)**: 2292–2333.

Murphy, M. O., Loria, A. S. 2017, Sex-specific effects of stress on metabolic and cardiovascular disease: are women at higher risk, *American Journal of* Physiology-*Regulatory, Integrative and Comparative* Physiology, **313**: 1–9.

Nelson, D. L., Cox, M. M. 2017, *Lehninger principles of biochemistry 7th ed*, New York: Worth Publishers.

Nordestgaard, B. G., Varbo, A. 2014, Triglycerides and cardiovascular disease*, Lancet*, **384(9943)**: 626–635.

Papagianni, A., Kokolina, E., Kalovoulos, M., Vainas, A., Dimitriadis, C., Memmos, D. 2004, Carotid atherosclerosis is associated with inflammation, malnutrition and intercellular adhesion molecule-1 in patients on continuous ambulatory peritoneal dialysis, *Nephrology Dialysis Transplantation*, **19**:1258–1263.

Patel, A., Barzi, F., Jamrozik, K., Lam, T. H., Ueshima, H., Whitlock, G., Woodward, M., *Asia Pacific Cohort Studies Collaboration*. 2004, Serum triglycerides as a risk factor for cardiovascular diseases in the Asia-Pacific region, *Circulation*, **110**(17), 2678–2686.

Picard, M, McManus, M. J., Gray, J. D., Nasca, C., Moffat, C., Kopinski, P. K., Seifert, E. L., McEwen, B. S., Wallace, D. C. 2015, Mitochondrial functions modulate neuroendocrine, metabolic, inflammatory, and transcriptional responses to acute psychological stress*, Proceedings of the National Academy of Sciences of the United States of America*, **112(48)**: E6614-E6623.

Rygiel K. 2018, Hypertriglyceridemia - Common Causes, Prevention and Treatment Strategies*, Current cardiology reviews*, **14(1)**, 67–76.

Samaan, R. A. 2017, *Dietary fiber for the prevention of cardiovascular disease: Fiber's interaction between gut micoflora, sugar metabolism, weight control and cardiovascular health*, California: Academic Press.

Schönfeld, P., Wojtczak, L. 2016, Short- and medium-chain fatty acids in energy metabolism: the cellular perspective, *Journal of lipid research*, **57(6)**: 943–954.

Seaton, T. B., Welle, S. L., Warenko, M. K., Campbell, R. G. 1986, Thermal effect of medium-chain and long-chain triglycerides in man, *American Journal of Clinical Nutrition*, **44**: 630–634.

Su, P., Hong, L., Zhao, Y., Sun, H., Li, L. 2015, Relationship Between Hyperuricemia and Cardiovascular Disease Risk Factors in a Chinese Population: A Cross-Sectional Study, *International medical journal of experimental and clinical research*, **21**: 2707–2717.

Sun, Y., Sun, J., Zhang, P., Zhong, F., Cai, J., Ma, A. 2019, Association of dietary fiber intake with hyperuricemia in U.S. adults*, Food & Function*, **10**: 4932-4940.

Surampudi, P., Enkhmaa, B., Anuurad, E., Berglund, L. 2016, Lipid Lowering with Soluble Dietary Fiber, *Current Atherosclerosis Reports*, **18(12)**: 75.

Traul, K. A., Driedger, A., Ingle, D. L., Nakhasi, D. 2000, Review of the toxicologic properties of medium-chain triglycerides, *Food and Chemical Toxicology*, **38**: 79–98.

Tsuji, H., Kasai, M., Takeuchi, H., Nakamura, M., Okazaki, M., Kondo, K. 2001, Dietary medium-chain triacylglycerols suppress accumulation of body fat in a double-blind, controlled trial in healthy men and women, *Journal of Nutrition*, **131**: 2853–2859.

Varbo, A., Benn, M., Nordestgaard, B. G. 2014, Remnant cholesterol as a cause of ischemic heart disease: evidence, definition, measurement, atherogenicity, high risk patients, and present and future treatment, *Pharmacology & therapeutics*, **141(3)**: 358–367.

Viecili, P. R. N., da Silva, B., Hirsch, G. E., Porto, F. G., Parisi, M. M., Castanho, A. R., Wender, M., Klafke, J. Z. 2017, 'Chapter One - Triglycerides Revisited to the Serial' in Makowski, G. S.*, Advances in Clinical Chemistry*, Volume 80, Elsevier, Philadelphia, pp 1-44.

Wang, Y., Liu, Z., Han, Y., Xu, J., Huang, W., Li, Z. 2018, Medium Chain Triglycerides enhances exercise endurance through the increased mitochondrial biogenesis and metabolism, *PloS one*, **13(2)**: e0191182.

Whisner, C. M., Angadi, S. S., Weltman, N. Y., Weltman, A., Rodriguez, J., Patrie, J. T., Gaesser, G. A. 2019, Effects of Low-Fat and High-Fat Meals, with and without Dietary Fiber, on Postprandial Endothelial

Function, Triglyceridemia, and Glycemia in Adolescents, *Nutrients*, **11(11)**: 2626.

Wu, X., Wakamiya, M., Vaishnav, S., Geske, R., Montgomery, C., Jr, Jones, P., Bradley, A., Caskey, C. T. 1994, Hyperuricemia and urate nephropathy in urate oxidase-deficient mice, *Proceedings of the National Academy of Sciences of the United States of America*, **91(2)**: 742–746.

Zhang, X., Meng, Q., Feng, J., Liao, H., Shi, R., Shi, D., Renqian, L., Langtai, Z., Diao, Y., Chen, X. 2018, The prevalence of hyperuricemia and its correlates in Ganzi Tibetan Autonomous Prefecture, Sichuan Province, China, *Lipids in health and disease*, **17(1)**: 235.