Scientific Research Publishing

Open Journal of Forestry, 2020, 10, 1-6
https://www.scirp.org/journal/ojf
ISSN Online: 2163-0437
ISSN Print: 2163-0429

Anti-Hypertensive Effects of Blended *Camellia oleifera* Abel Oil and Eucommia Extract on SHR Mice

Menghao Du, Lisong Hu, Xuezhi Fang, Jingping Zhang

Research Institute of Subtropical Forestry, Chinese Academy of Forestry, Fuyang, China
Email: xiaoduchongcn@aliyun.com

How to cite this paper: Du, M. H., Hu, L. S., Fang, X. Z., & Zhang, J. P. (2020). Anti-Hypertensive Effects of Blended *Camellia oleifera* Abel Oil and Eucommia Extract on SHR Mice. *Open Journal of Forestry, 10,* 1-6.
https://doi.org/10.4236/ojf.2020.101001

Received: October 25, 2019
Accepted: November 25, 2019
Published: November 28, 2019

Abstract

In our study, we employed Camellia seed oil as the main ingredients blended with Eucommia Extract to investigate the effects of anti-hypertensive on mice by administrating mice with low dose, middle dose and high dose of Camellia seed oil complex for 4 weeks. The specific tests of studying effects of anti-hypertensive were body weight, blood systolic pressure (BSP), diastolic blood pressure (DBP), pm meam blood pressure (MBP) and heart rate (HR). And the results showed that appropriate level of Camellia seed oil complex could decrease the body weight and had an active effect on the cardiovascular system of mice, which significantly embodied the anti-hypertensive activity of Camellia seed oil complex.

Keywords

Camellia Seed Oil, Eucommia Extract, Anti-Hypertensive, Mice

1. Introduction

Camellia (*Camellia oleiferous* Abel.) seed oil is unique woody oil in China which is widely used in south of China as edible oil, medicine and burning injury for thousands of years. It has high nutritional value and has been considered a popular healthy food because it mainly composed of unsaturated fatty acids and a small amount of saturated fatty acids. Furthermore, it contains a considerable numbers of bioactive phytochemicals such as phytosterols, squalenes and tocopherol. Its fatty acid composition is similar to olive oil, which known as the "queen of vegetable oil" (Xiao, 2015). The content of unsaturated fatty acid is over 90%, oleic acid is up to 80% (Zhu et al., 2012; Dong, 2011; Chen, 2011) and some nutrients are even higher than olive oil (Zhong et al., 2006). The Camellia

seed oil is applied as functional food and food supplementary to help patients reduce contents of cholesterol and triglycerides in blood (Lee & Yen, 2006; Fedeli et al., 1966). Zhang and Zhou et al. reported that tea oil had antioxidant ability against several degenerative pathologies, including cardiovascular diseases and cancer (Zhang & Zhou, 1995). Moreover, the Camellia seed oil was shown to have an anti-obesity effect *in vivo* model. However, little information has been devoted to the anti-fatigue effects of the tea seed oil.

The extract of eucommia ulmoides had higher chlorogenic acid (Zang, 1989) and chlorogenic acid has a variety of pharmacological effects such as cholagogic, antibacterial, antiviral, anti-hypertensive, raising white blood cells and stimulating the central nervous system (Zhang et al., 2001). So it is an important raw material for health care, food, medicine, cosmetics and other industries.

Our goal is to evaluate the effect of anti-hypertensive activity of the complex of Camellia seed oil blended Eucommia extract in mice. And we will evaluate the possibility of Camellia seed oil blended Eucommia extract as human daily food in next studying.

2. Materials and Methods

2.1. Materials

Tea seed oil from Camellia oleifera Abel was obtained by cold-press technique from Jiande Xiawu Agriculture Development Co., Ltd., Zhejiang, China.

Eucommia Extracts were purchased from Qingdao New Research Nonferrous Metal Co., Ltd., Qingdao, China.

Tea seed oil complex: adding the tea seed oil and Eucommia Extract, with the ratio of (100:1), at 30˚C - 70˚C in a flask, the mixture was stirred fiercely with T25 digital ultra-turrax high-speed homogenizer, IKA Co., Germany, till the tea seed oil and Eucommia Extract distributed well and keep at 4˚C in refrigerator.

Solvent: Sucrose fatty acid esters were purchased from Mitsubishi Corporation of Japan. Adding 2% sucrose fatty acid esters in 1000 ml distilled water (98˚C), the mixture was stirred fiercely with T25 digital ultraturrax high-speed homogenizer, IKA Co., Germany, till the mixture was distributed well and cooled down.

2.2. Animals

SHR mice (SPF Grade, male, 10 weeks old) and Wistar mice (SPF Grade, male, 10weeks old) were purchased from Shanghai slack laboratory animal Co. Ltd. (SCXK (Hu) 2007-0005). All animal procedures performed were in accordance with the standard Guidelines for Animal Studies and approved by the Institutional Animal Ethics Committee.

2.3. Methods

After being fed for 20 days, 50 male SHR mice were divided into 4 groups randomly according to their basic blood pressure and body weights. one group named model control group (MCG) was supplemented with 10 ml·kg^{-1} solvent

day^{-1} by oral intake in the food, the other three group named low dose group (LDG), middle dose group (MDG) and high dose group (HDG) were administrated 0.5, 1.0 and 2.0 g·kg^{-1}·day^{-1} of tea seed oil complex by oral intake respectively. 10 male Wistar mice as normal control group (NCG) was administrated 10 ml·kg^{-1} solvent day^{-1} by oral intake. Mice were performed the weight test, blood pressure measurement and heart rate test at the 0 week, 1st week, 2nd week, 3rd weeks and 4th weeks.

2.4. Condition

Mice were housed in SPF Laboratory maintained at 22˚C ± 1˚C, 50% - 70% humidity and 150 - 200 Lx intensity of light with a 12 h light/dark cycle. 60 mice were randomly divided into polycarbonate cages. 5 mice in each set allowed free access to eat and drink water. The water was filtered and sterilized. And the feed was radioactive by Co 60 to sterilize.

2.5. Instrument

ALC-NIBP Noninvasive blood pressure measurement system of rat tail artery, Shanghai Alcott biotechnology Co., Ltd.

MLS-3020 High pressure sterilizer, Sanyo electronics Co., Ltd. of Japan.

AG204 Alectronic analytical balance METTLER Co., Ltd. of Swiss land.

2.6. Data Statistics

Data were analyzed using SPSS 11.5 version (SPSS Inc., Chicago, IL, USA). The results were demonstrated as the mean ± S. The significance of the mean difference between the control groups and each treatment group was performed by one-way AVOVA test.

3. Result

3.1. Different Treatment Groups Body Weight

Comparing with NCG，MCG the initial body weight was significantly higher than that of NCG ($P < 0.01$), however, after feeding 3 weeks, MCG the body weight was significantly lower than that of NCG ($P < 0.05$). LDG, MDG and HDG comparing with MCG, there was no significant change in body weight ($P > 0.05$) after feeding 4 weeks (Table 1).

Table 1. Different treatment groups body weight (g, $n = 10$, $\bar{X} \pm s$).

Group	Doseage	Initial Weight	1 Week	2 Week	3 Week	4 Week
NCG	10 ml·kg^{-1} solvent	311.0 ± 11.5	346.4 ± 12.6	358.5 ± 18.3	374.3 ± 20.0	375.9 ± 20.5
MCG	10 ml·kg^{-1} solvent	337.9 ± 20.0$^{\Delta\Delta}$	352.2 ± 20.3	354.3 ± 20.1	352.4 ± 21.3$^{\Delta}$	354.8 ± 23.0$^{\Delta}$
LDG	0.5 g·kg^{-1} oil	344.5 ± 15.3	359.7 ± 15.3	363.9 ± 14.4	365.7 ± 16.8	366.7 ± 17.8
MDG	1.0 g·kg^{-1} oil	331.7 ± 18.6	341.6 ± 18.8	345.0 ± 17.2	350.3 ± 17.2	350.0 ± 18.7
HDG	2.0 g·kg^{-1} oil	339.3 ± 27.2	351.5 ± 25.5	358.4 ± 24.1	362.2 ± 18.8	359.0 ± 16.8

Significantly different from the normal control group, $^{\Delta}P < 0.05$, $^{\Delta\Delta}P < 0.01$; Significantly different from the model control group, $^{*}P < 0.05$, $^{**}P < 0.01$.

3.2. Effects of Tea Seed Oil Complex on BSP of Mice

Comparing with NCG, the blood systolic pressure (BSP) of MDG was significantly higher than that of NCG in 4 weeks test ($P < 0.01$). Comparing with MCG, the BSP of HDG decreased significantly after feeding 2, 3 and 4 weeks ($P < 0.05$, $P < 0.01$), the BSP of MDG decreased significantly after feeding 2 and 4 weeks ($P < 0.05$, $P < 0.01$), the BSP of LDG decreased significantly after feeding 2 weeks ($P < 0.05$) (Table 2).

3.3. Effects of Tea Seed Oil Complex on DBP of Mice

Comparing with NCG, the diastolic blood pressure (DBP) of MDG was significantly higher than that of NCG in 4 weeks test ($P < 0.01$). Comparing with MCG, the DBP of HDG decreased significantly after feeding 2, 3 and 4 weeks ($P < 0.05$, $P < 0.01$), the DBP of MDG decreased significantly after feeding 2 and 4weeks($P < 0.05$, $P < 0.01$), the DBP of LDG decreased significantly after feeding 2 weeks ($P < 0.05$) (Table 3).

3.4. Effects of Tea Seed Oil Complex on MBP of Mice

Comparing with NCG, the pm meam blood pressure (MBP) of MDG was significantly higher than that of NCG in 4 weeks test ($P < 0.01$). Comparing with MCG, the MBP of HDG decreased significantly after feeding 2, 3 and 4 weeks ($P < 0.05$, $P < 0.01$), the MBP of MDG decreased significantly after feeding 2 and 4 weeks ($P < 0.05$, $P < 0.01$), the MBP of LDG decreased significantly after feeding 2 weeks ($P < 0.05$) (Table 4).

Table 2. Effects of tea seed oil complex on BSP of mice (mmHg, $n = 10$, $\bar{X} \pm s$).

Group	Doseage	Initial BSP	1 Week	2 Week	3 Week	4 Week
NCG	10 ml·kg^{-1} solvent	136.6 ± 18.2	134.3 ± 22.2	133.5 ± 22.5	144.5 ± 8.8	145.4 ± 10.3
MCG	10 ml·kg^{-1} solvent	192.5 ± 10.5$^{\Delta\Delta}$	183.1 ± 8.5$^{\Delta\Delta}$	209.8 ± 2.4$^{\Delta\Delta}$	204.0 ± 6.8$^{\Delta\Delta}$	216.3 ± 5.1$^{\Delta\Delta}$
LDG	0.5 g·kg^{-1} oil	192.0 ± 10.4	181.3 ± 19.8	197.0 ± 15.2*	199.9 ± 14.2	207.8 ± 10.7
MDG	1.0 g·kg^{-1} oil	191.0 ± 12.5	182.3 ± 17.0	191.2 ± 12.1**	202.6 ± 11.4	205.0 ± 12.2*
HDG	2.0 g·kg^{-1} oil	192.8 ± 15.2	173.0 ± 23.7	186.2 ± 12.1**	195.9 ± 7.0*	190.9 ± 18.3**

Significantly different from the normal control group, $^{\Delta}P < 0.05$, $^{\Delta\Delta}P < 0.01$; Significantly different from the model control group, $^{*}P < 0.05$, $^{**}P < 0.01$.

Table 3. Effects of tea seed oil complex on DBP of mice (mmHg, $n = 10$, $\bar{X} \pm s$).

Group	Doseage	Initial DBP	1 Week	2 Week	3 Week	4 Week
NCG	10 ml·kg^{-1} solvent	102.8 ± 15.0	101.6 ± 19.5	101.9 ± 17.4	109.3 ± 7.2	107.6 ± 7.7
MCG	10 ml·kg^{-1} solvent	143.4 ± 9.4$^{\Delta\Delta}$	138.2 ± 9.8$^{\Delta\Delta}$	156.1 ± 5.5$^{\Delta\Delta}$	154.3 ± 7.3$^{\Delta\Delta}$	158.6 ± 7.5$^{\Delta\Delta}$
LDG	0.5 g·kg^{-1} oil	143.0 ± 10.4	136.5 ± 10.7	147.2 ± 10.4*	149.8 ± 9.6	153.0 ± 5.9
MDG	1.0 g·kg^{-1} oil	143.0 ± 11.3	136.1 ± 12.8	140.6 ± 7.7**	147.4 ± 9.0	149.5 ± 8.9*
HDG	2.0 g·kg^{-1} oil	142.4 ± 13.8	128.4 ± 15.7	139.9 ± 13.0**	144.7 ± 5.6*	140.3 ± 12.1**

Significantly different from the normal control group, $^{\Delta}P < 0.05$, $^{\Delta\Delta}P < 0.01$; Significantly different from the model control group, $^{*}P < 0.05$, $^{**}P < 0.01$.

3.5. Effects of Tea Seed Oil Complex on HR of Mice

Comparing with NCG, the heart rate (HR) of MDG was significantly higher than that of NCG in 4 weeks test ($P < 0.05$, $P < 0.01$). However, comparing with MCG, there was no significant change in HR ($P > 0.05$) between LDG, MDG and HDG to MCG after feeding 4 weeks (Table 5).

4. Discussion and Conclusion

The initial body weight of MCG was heavier than that of NCG, however, the body weight of MCG was lighter than that of NCG after 3 weeks feeding (Table 1). It suggested that Camellia seed oil blended Eucommia extract has the function of control body weight. In fact, obesity can lead to serious health issues, like cardiovascular disease (Wang et al., 2014). Furthermore, the complex of Camellia seed oil blended Eucommia extract can decrease BSP, DBP, MBP and HR (Tables 2-5). Our results demonstrated that the complex of Camellia seed oil blended Eucommia extract did good things to the cardiovascular system of SHRmice. The reason is that Camellia seed oil contained a great deal of unsaturated fatty acid (Oleic acid > 80%, $\omega 9$) and micronutrient (phytosterols, squalenes and tocopherol) (Zhong et al., 2006). Oleic Acid Protects from Arsenic-Induced Cardiac Hypertrophy via AMPK/FoxO/NFATc3 Pathway (Samanta et al., 2019).

In conclusion, our results suggest that Camellia seed oil complex had significant anti-hypertensive effects on mice and these effects were dose-dependent. When dosage was high, it normally would improve the effects much better.

Table 4. Effects of tea seed oil complex on MBP of mice (mmHg, $n = 10$, $\bar{X} \pm s$).

Group	Doseage	Initial MBP	1 Week	2 Week	3 Week	4 Week
NCG	10 ml·kg^{-1} solvent	114.0 ± 15.8	112.5 ± 20.3	112.4 ± 19.0	121.0 ± 7.4	120.2 ± 8.3
MCG	10 ml·kg^{-1} solvent	159.8 ± 9.4$^{\Delta\Delta}$	153.2 ± 9.1$^{\Delta\Delta}$	174.0 ± 4.3$^{\Delta\Delta}$	170.8 ± 6.9$^{\Delta\Delta}$	177.8 ± 6.3$^{\Delta\Delta}$
LDG	0.5 g·kg^{-1} oil	159.3 ± 10.0	151.5 ± 13.5	163.8 ± 11.8*	166.5 ± 10.9	171.3 ± 6.8
MDG	1.0 g·kg^{-1} oil	159.0 ± 11.2	151.5 ± 13.3	157.5 ± 8.8**	165.8 ± 9.6	167.6 ± 9.4*
HDG	2.0 g·kg^{-1} oil	159.2 ± 13.7	143.3 ± 18.2	155.3 ± 12.3**	161.8 ± 5.8*	157.1 ± 13.7**

Significantly different from the normal control group, $^{\Delta}P < 0.05$, $^{\Delta\Delta}P < 0.01$; Significantly different from the model control group, $^{*}P < 0.05$, $^{**}P < 0.01$.

Table 5. Effects of tea seed oil complex on HR of mice (bpm, $n = 10$, $\bar{X} \pm s$).

Group	Doseage	Initial HR	1 Week	2 Week	3 Week	4 Week
NCG	10 ml·kg^{-1} solvent	379.0 ± 39.7	371.3 ± 52.0	355.8 ± 40.5	343.4 ± 23.5	332.5 ± 21.7
MCG	10 ml·kg^{-1} solvent	420.7 ± 29.1$^{\Delta}$	411.3 ± 46.9$^{\Delta\Delta}$	417.6 ± 26.3$^{\Delta\Delta}$	422.7 ± 27.2$^{\Delta\Delta}$	413.2 ± 30.8$^{\Delta\Delta}$
LDG	0.5 g·kg^{-1} oil	425.6 ± 49.8	422.0 ± 37.2	429.3 ± 39.8	424.6 ± 31.6	437.5 ± 31.9
MDG	1.0 g·kg^{-1} oil	405.9 ± 34.0	431.9 ± 20.9	414.0 ± 35.3	443.9 ± 27.2	417.8 ± 42.7
HDG	2.0 g·kg^{-1} oil	439.0 ± 37.4	445.8 ± 36.2	428.5 ± 35.4	443.4 ± 21.3	419.9 ± 40.5

Significantly different from the normal control group, $^{\Delta}P < 0.05$, $^{\Delta\Delta}P < 0.01$; Significantly different from the model control group, $^{*}P < 0.05$, $^{**}P < 0.01$.

Acknowledgements

This work was supported by the project of Science and Technology Department of Zhejiang Province, China (2017C02003).

Conflicts of Interest

The authors declare that they have no competing interests.

References

Chen, X. Y. (2011). *Comparative Study on Three Methods for the Extraction of Oil from Camellia Seed.* Northwest Agriculture and Forestry University.

Dong, J. Y. (2011). *Research of Consumer Buying Behavior of Tea-Seed Oil Based on the Value Cognition.* Fujian Agriculture and Forestry University.

Fedeli, E., Lanzani, A., Capella, P., & Jacini, G. (1966). Triterpene Alcohols and Sterols of Vegetable Oils. *Journal of the American Oil Chemists' Society, 43,* 254-256. https://doi.org/10.1007/BF02641098

Lee, C. P., & Yen, G. C. (2006). Antioxidant Activity and Bioactive Compounds of Tea Seed (*Camellia oleifera* Abel.) Oil. *Journal of Agricultural and Food Chemistry, 54,* 779-784. https://doi.org/10.1021/jf052325a

Samanta, J., Mondal, A., Saha, S., Chakraborty, S., & Sengupta, A. (2019). Oleic Acid Protects from Arsenic-Induced Cardiac Hypertrophy via AMPK/FoxO/NFATc3 Pathway. *Cardiovascular Toxicology,* 1-20. https://doi.org/10.1007/s12012-019-09550-9

Wang, Z. W., Hao, G., Wang, X., Chen, Z., Zhang, L. F., Guo, M., Tian, Y., Shao, L., Zhu, M. L., & Wu, K. G. (2014). Current Prevalence Rates of Overweight, Obesity, Central Obesity, and Related Cardiovascular Risk Factors that Clustered among Middle-Aged Population of China. *Chinese Journal of Hypertension, 22,* 1000.

Xiao, Y. P. (2015). *Research of Unsaponifiable Substances in Tea Seed Oil and Camellia Oleifera Seed Oil.* Nanchang University, Jiangxi, China.

Zang, Y. W. (1989). Advances in Chemical Constituents of Eucommia Ulmoides. *Chinese Traditional and Herbal Drugs, 20,* 42-44.

Zhang, A. L., Ma, Q., Gao, J. M., Zhang, K. J., & Wang, L. (2001). Studies on Bioactivities of Chlorogenic Acid and Itsanalogues. *Chinese Traditional and Herbal Drugs, 2,* 79-82.

Zhang, B., & Zhou, Y. (1995). Effects of Tea Seed Oil and Soybean Oil on Oxygen Radical and Activities of Antioxidative Enzymes in Rat. *Acta Nutrimenta Sinica, 17,* 1432-1338.

Zhong, H. Y., Bedgood, D. R., Bishop, A. G., Prenziler, P. D., & Pobards, K. (2006). Effect of Added Caffeic Acid and Tyrosol on the Fatty Acid and Volatile Profiles of Camellia Oil Following Heating. *Journal of Agricultural and Food Chemistry, 54,* 9551-9558. https://doi.org/10.1021/jf061974z

Zhu, Y., Zhong, H. Y., Sun, H. Z., Zhou, B., Long, Q. Z., & Zhu, P. (2012). Development of Quantitative Analysis of Fatty Acid for Monitoring Changes of Fatty Acid Profile of Camellia Oil. *Advanced Materials Research, 554-556,* 1202-1210. https://doi.org/10.4028/www.scientific.net/AMR.554-556.1202