https://africanjournalofbiomedicalresearch.com/index.php/AJBR
Afr. J. Biomed. Res. Vol. 27 (September2024); 310-314

Research Article

Effect of Adding Natural Honey Intake to Continuous Aerobic Exercise on Lipid Profile in Overweight Men

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ABSTRACT

Objective: This study aimed to assess the effect of adding natural honey intake to continuous aerobic exercise on lipid profile in overweight men.

Methods: Sixty overweight men aged 40-50 years old were randomly assigned into one of two groups: study or control groups. The study group (n=30) received 40-minute continuous aerobic exercise on the treadmill three times weekly plus oral honey intake thrice daily. The control group (n=30) received only the aerobic exercise. Patients' waist-hip ratio (WHR), high-density lipoprotein (HDL), atherogenic index of plasma (AIP), low-density lipoprotein (LDL), total cholesterol (TC), body mass index (BMI), and triglycerides (TG) were assessed in both overweight groups.

Results: After the 12-week intervention, a significant improvement of BMI, TC, TG, WHR, LDL, AIP, and HDL was documented within both overweight groups, but a better improvement was detected in the study group (the group of oral honey intake). Post-treatment between-group comparison of all outcomes (BMI, TC, TG, WHR, LDL, AIP, and HDL) showed a significant improvement in the direction of the study group.

Conclusion: It could be concluded from this trial that adding a 12-week oral honey intake to aerobic exercise maximizes the improvement of lipid profile gained from aerobic exercise alone in overweight men.

Keywords: Honey; Exercise; Lipid profile; Overweight; Obesity.

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Received: 02/07/2024 Accepted: 05/08/2024

DOI: https://doi.org/10.53555/AJBR.v27i3.1627

INTRODUCTION

"Abnormal or excessive fat accumulation in different body parts that may impair health" is the definition of both overweight and obesity **(Hamjane et al., 2019) (Ismail & Hamed, 2024) (Ismail, 2023A) (Ismail et al., 2023A)**. Dyslipidaemia is a common cardiovascular risk factor that is highly reported in overweight/obese individuals **(Ismail, 2023B)**. Increasing physical activity – via the performance of regular exercise sessions - is still the cornerstone of treating overweight and its complications such dyslipidemia. The functional and structural adaptation of overweight persons' different body systems to the corresponding metabolic challenge of the regular performance of physical exercise may be the explained cause of improved dyslipidemia after exercise **(Benite-Ribeiro et al., 2020)**.

Exercise-induced improvement in the concentration of plasma triglyceride (TG), total cholesterol (TC), low-density lipoprotein (LDL), or high-density lipoprotein (HDL) is primarily due to the upregulation /enhancement of lipolytic enzymes' activity and quantity in skeletal muscle that utilize

lipids (mainly TG) as a primary source of energy during long-term exercise **(Ismail, 2022)**.

Regretfully, individuals who are overweight or obese find it difficult to follow or adhere to a regular schedule of exercise regimens/programs **(Astrup & Bügel, 2019) (Ismail et al., 2024)**. The growing/increasing tendency of physical inactivity and sedentary lifestyle in modern societies is attributed to a number of suggested factors/causes, including hectic/busy schedules, increased automation at workplaces, and excessive unjustified use of transportation, elevators, *etc*. Because of the shown effectiveness and efficacy of therapeutic/medicinal foods like honey, alternative weight-loss strategies/protocols have drawn the attention of overweight people who are at risk and have supplanted conventional weight-lowering techniques/methods **(Esteghamati et al., 2015)**.

Honey – as a supplemental medicinal food therapy – is a natural sweetener. Bees collect plants' nectar or the secretions of aphids (plant-sucking insects) to produce honey. Due to the presence of highly active components which have beneficial effects on carbohydrate and lipid metabolism, Hioney is used by humans **(Cortés et al., 2011)** to lower hypertriglyceridemia, decrease, hyperlipoproteinemia, ameliorate excessive body weight, and improve cardiovascular risk factors **(Ramli et al., 2018)**.

This study aimed to investigate the effect of adding oral honey intake to continuous aerobic exercise on lipid profile in overweight men.

Materials and methods

Design

This study was a randomized controlled complementary trial in overweight men who were treated via exercise alone or combined with oral honey intake.

Settings

The exercise part of this study was conducted at the physiotherapy outpatient clinic of King Khaled Hospital, Najran, Saudi Arabia.

Ethics

Before consenting, all details related to the oral intake of honey and the application of the exercise program were provided to overweight men. Besides the local ethical approval, Helsinki recommendations and withdrawal rights were followed and explained to patients.

Inclusion criteria

All participants were sixty overweight men. Men's body mass index (BMI) ranged from 25-29.9 Kg/m^2. Men's ages ranged from 40-50 years old.

Exclusion criteria

Men with neurological complaints or orthopedic problems (old trauma, congenital deformities, arthritis, *etc*.) in the lower limb and those with metabolic syndrome or one of its components were excluded. Men who followed exercise, pharmacological, or herbal prescriptions for weight loss were also excluded. Smoker men or men with any chronic disorder in the pulmonary, cardiovascular, renal, or hepatic systems were excluded. Men who showed or reported food allergies from honey were excluded.

Randomization

Overweight men were randomized to the study group (n=30 overweight men who received 40-minute continuous aerobic exercise on a treadmill three times weekly plus oral honey intake thrice daily) or control group (n=30 overweight men who received only the designed aerobic exercise program of the study group).

Interventions

Aerobic training

Overweight men in both trained groups received walking sessions on the treadmill thrice weekly. For 12 weeks, the session was started with a treadmill walking at 40–60% of overweight men's maximal heart rate (MHR, as a warming-up phase for 5 minutes), followed by 30-minute treadmill walking at 60–75% of overweight men's MHR, then, like the warming-up phase, the session was finalized with cooling-down phase **(Ismail et al., 2023B)**.

Honey intake

The overweight men in the study group consumed raw, natural, unprocessed, non-heated multifloral honey in an oral dose of 2 g/kg/day. Assuming a man's body mass was 75 kg, 150 grams of honey was consumed daily. This oral dose was divided into three doses (50 grams for every dose). Thirty minutes before meals, for 12 weeks, the 50-gram oral dose of honey was consumed daily **(Abdulrhman, 2016)**. The honey used in this study was flower honey (Rashof Honey, 500-gram jar, 100% natural and pure honey, made in Saudi Arabia).

For each overweight man in the study group, throughout the study that was conducted from April to July 2024, a daily telephone call was made by the first researcher at the time of oral honey intake to ensure that the honey was consumed by the men.

Outcomes

Besides BMI, wait-hip ratio (WHR) and lipid profile in the form of HDL, LDL, TC, and TG were estimated.

Also, the atherogenic index of plasma (AIP), a new marker or indicator of atherosclerosis risk in obesity was estimated. AIP is a new marker of atherogenicity that is related directly to atherosclerosis risk. The equation of AIP (mmol/L) was calculated as follows: AIP = log10 (TG/HDL) **(Shen et al., 2017)**.

Statistical analysis

To verify the normal distribution of overweight men's data, Shapiro-Wilk was employed. All overweight men's data were normally distributed. The unpaired t-test was used to compare groups' ages before starting the allocated interventions (exercise alone or combined with natural oral intake of honey). Within- and between-group comparison of BMI, lipids, AIP, and WHR was examined using MANOVA at a significance level of $p\text{-value} < 0.05$.

Results

Before the 12-week intervention (exercise alone or combined with natural oral intake of honey), regarding overweight men's demographic data (WHR, age, and BMI that are shown in **Table 1**), TC, TG, AIP, LDL, and HDL **(Table 2)** reported no significant difference between men groups.

Table 1. Basic (main) data of trained overweight men

Data	Study group	Group B	T value	P value
Age (years)	44.50±3.08	45.16±3.18	-0.82	0.413
Body mass index (kg/m^2)	27.30±1.48	27.97±1.47	-1.76	0.084
Waist hip ratio	0.88±0.06	0.90±0.06	-1.30	0.196

All data of treated overweight men are expressed as mean±SD

After the 12-week intervention (exercise alone or combined with natural oral intake of honey), a significant improvement in overweight men's BMI, WHR, TC, TG, AIP, LDL, and HDL was documented within both groups but the better level of improvement was detected in the study group (the group that received exercise combined with natural oral intake of honey). Post-treatment between-group comparison of all outcomes showed a significant improvement in the direction of the study group (the group that received exercise combined with natural oral intake of honey) **(Table 2)**.

Table 2. Outcomes of overweight men after 12 weeks.

Outcomes	Study group	Control group	P value (between groups)
Body mass index (kg/m^2)	**Mean±SD**	**Mean±SD**	
Before	27.30±1.48	27.97±1.47	0.084
After	25.78±1.40	26.88±1.46	0.004*
P value (within groups)	<0.001*	<0.001*	
Waist-hip ratio (%)	**Mean±SD**	**Mean±SD**	
Before	0.88±0.06	0.90±0.06	0.196
After	0.80±.06	0.84±0.06	0.007*
P value (within groups)	<0.001*	<0.001*	
Triglycerides (mg/dl)	**Mean±SD**	**Mean±SD**	
Before	127.60±14	134.16±12.47	0.06
After	116.36±12.70	124.70±11.82	0.01*
P value (within groups)	<0.001*	<0.001*	
Total cholesterol (mg/dl)	**Mean±SD**	**Mean±SD**	
Before	186.83±32.46	198.96±30.93	0.144
After	166.03±29.35	182.66±33.29	0.045*
P value (within groups)	<0.001*	<0.001*	
Low-density lipoprotein (mg/dl)	**Mean±SD**	**Mean±SD**	
Before	105.03±11.73	110.96±12.52	0.063
After	89.33±10.85	97.96±12.92	0.007*
P value (within groups)	<0.001*	<0.001*	
High-density lipoprotein (mg/dl)	**Mean±SD**	**Mean±SD**	
Before	53.56±9.64	49.20±7.64	0.057
After	57.93±9.60	51.83±7.58	0.008*
P value (within groups)	<0.001*	<0.001*	
Atherogenic index of plasma	**Mean±SD**	Mean±SD	
Before	0.37±0.10	0.41±0.08	0.178
After	0.30±0.09	0.35±0.09	0.036
P value (within groups)	<0.001*	<0.001*	

SD: Standard deviation; *: Overweight men's P value is significant ($P < 0.05$)

Discussion

This study approved that adding a 12-week oral intake of honey to the regular performance of aerobic exercise maximizes the anti-atherosclerotic, hypolipidemic, and weight-reducing effects of exercise in overweight men.

The ability of honey to reduce overweight men's BMI could be explained by the presence of honey-containing mono-and disaccharides (*e.g.* glucose, fructose, maltose, and sucrose) that can be quickly digested, absorbed, and metabolized. These mono-and disaccharides (mainly fructose constitute 35–45% of honey) delay gastric emptying and lower food consumption **(Terzo et al., 2020)**.

Due to the laxative effect of honey, honey-induced removal of body water which constitutes the majority of overweight men's body composition is the cause of reduced weight after the oral intake of honey. Besides its ability to promote lipolysis and prevent lipogenesis, the ability of honey to produce hydrogen peroxide from honey-containing glucose improves weight loss. Hydrogen peroxide has an insulin-like action that increases

metabolic rate. Enhanced metabolic rate may be the cause of weight loss after regular honey intake **(Ugusman et al., 2022)**.

Honey sweetness-influencing satiety or increased leptin sensitivity causes less energy intake. The decrease in energy intake of the oral intake of honey may be the cause of the decreased overweight men's BMI and WHR in this clinical trial **(Al-Tamimi et al., 2020)**.

Besides the ability of honey-containing antioxidants (*e.g.* beta-carotenes, niacin, nitric oxide, vitamin C, vitamin B, vitamin A, uric acid, and other different trace minerals/elements like zinc and copper) to increase body fats' catabolism and reduce lipid levels in the blood **(Bahrami et al., 2009)**, these honey-containing antioxidants inhibit oxidative stress and the formation of atherogenic plaques **(Yaghoobi et al., 2008)**, hence the chance of early atherosclerosis in overweight patients decreases.

The decrease in overweight men's TG concentrations after honey intake could be justified by the presence of honey-containing non-digestible components (*e.g.* isomaltulose components) that had hypotriglyceridemic effects by decreasing TG production and/or TG clearance from the bloodstream **(Al-Tamimi et al., 2020)**.

After receiving 70 grams of honey per day for six weeks, our results were supported by an Iranian study that indicated an improvement in lipids (TC, TG, LDL, and HDL) in healthy young men aged 18–30 years **(Rasad et al., 2018)**.

Our study's results were corroborated by another complementary study that found that giving diabetic (insulin-resistant) participants natural honey for eight weeks boosted their HDL and decreased their TC, LDL, and TG levels **(Bahrami et al., 2009)**.

Additionally, in overweight or obese individuals, **Yaghoobi et al. (2008)** reported that the daily consumption of 70 grams of pure/natural honey for 30 days did not result in weight gain and was shown to lower cardiovascular disease risk factors.

Al-Waili's (2004) clinical study showed that after 14-day consumption of honey (1.2 g/kg body weight/day), the blood lipid profiles of both healthy individuals and patients with diabetes and dyslipidemia significantly improved.

Also, in another study in which there was a consumption of natural honey for four weeks in healthy subjects, the significantly improved results of subjects' lipids were similar to our results **(Majid et al., 2013)**.

Also, 48-day consumption of honey applied along with lifestyle modifications approved the anti-hyperlipidemic and weight-reducing effects of honey because honey consumption reported a significantly improved weight, WHR, and lipid profile in obese individuals **(Pai et al., 2018)**.

Eating honey decreased the levels of LDL and BMI in females with hypercholesterolemia but, contrary to some of the presented results of our study, it did not significantly lower/decrease them in males. This suggests that the reason/cause for the difference in reported females' results may be attributed to women's sex hormones like estrogen, which have protective effects on high TC levels **(Münstedt et al., 2009)**.

In another study that opposed us, 10 g of natural honey per day for 70 days improved diabetic patients' lipid profile, but these changes/improvements were not statistically significant **(Bekkaye et al., 2016)**.

Limitations

Tracking the overweight subjects' outcomes (BMI, TC, TG, WHR, LDL, AIP, and HDL) was the limitation of this trial that must be covered in future trials.

Conclusion

Based on the results of this clinical trial, Adding an oral honey intake to a continuous aerobic exercise program increases the improvements in overweight men's weight and lipid profile.

Acknowledgments

None.

Funding

This study conducted on 60 overweight subjects did not receive any financial support.

Conflict of interests

The authors of this study conducted on 60 overweight subjects report no conflict of interest.

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