Short communication

Does short-term lemon honey juice fasting have effect on lipid profile and body composition in healthy individuals?

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1. Introduction

Fasting is an important treatment modality of naturopathy, based on providing rest to the digestive system, diverting vital energy otherwise utilized to digest food to the process of healing body and mind [11]. Plasma level of Vitamin-C status is inversely related to body mass and degree of obesity [2]. Low plasma levels of Vitamin-C are reported to be associated with the increased body mass index (BMI), central fat distribution, increased all-cause mortality, the risk of myocardial infarction, and gallbladder disease [3]. Whereas increased Vitamin-C intake was reported to be associated with higher high-density lipoprotein cholesterol (HDL-C) levels in increased Vitamin-C intake was reported to be associated with the increased body mass index (BMI), central fat distribution, increased all-cause mortality, the risk of myocardial infarction, and gallbladder disease [3]. Whereas increased Vitamin-C intake was reported to be associated with higher high-density lipoprotein cholesterol (HDL-C) levels in increased Vitamin-C intake was reported to be associated with the increased body mass index (BMI), central fat distribution, increased all-cause mortality, the risk of myocardial infarction, and gallbladder disease [3]. Whereas increased Vitamin-C intake was reported to be associated with higher high-density lipoprotein cholesterol (HDL-C) levels in normal as well as hyperlipidemic individuals [6]. Lemon honey juice fasting (LHJF) is a commonly used treatment modality in naturopathic hospitals in obesity, hypertriglyceridemia, dyslipidemia, alcoholic liver disorders, etc. but there is a lack of evidence showing its effects on body composition and lipid profile, especially in short interval. This preliminary study aims at evaluating the short-term physiological changes of LHJF on body composition, total serum triglycerides (TSTGs), and total serum cholesterol (TSCH) in healthy individuals.

2. Materials and methods

2.1. Subjects

Fifty participants (32 females) aged 18–29 years were recruited from a residential campus of the college of naturopathy and yogic sciences. Study protocol was approved by the institutional ethics committee and written informed consent was obtained from the participants. Sample size was not calculated based on any previous studies. Participants who met the following inclusion and exclusion criteria were recruited for the study.

**Criteria for Inclusion:**
- Healthy individuals aged 18–29 years
- No history of chronic diseases
- No history of medication intake

**Criteria for Exclusion:**
- Pregnant or lactating women
- History of chronic disease
- History of medication intake
- Body mass index (BMI) outside the normal range
- Alcohol consumption

Participants were instructed to maintain their usual dietary habits and physical activity levels during the study period.

Within group analysis of females showed similar results, unlike males. Our results suggest that LHJF may be useful for reduction of body weight, BMI, FM, FFM, and TSTG in healthy individuals, which might be useful for the prevention of obesity and hypertriglyceridemia.

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2.1. Inclusion criteria
Both genders, willing to participate in the study.

2.1.2. Exclusion criteria
Participants with a history of any systemic diseases or regular medication for any disease; females during menstruation and pregnancy; active in any exercise/sports program.

2.2. Study design
This was a single group study with pre- and post-design. In this preliminary study, baseline assessments were done (n = 50) before the intervention. Forty-four participants completed the study and contributed to the second assessment after 4-day of intervention. The reason for dropouts in study group (n = 6) was unwillingness to continue fasting due to personal problem (n = 5) and abdominal pain (n = 1).

2.3. Assessments
Assessments were done before and after 4-day of intervention. Body composition was measured using TANITA body composition analyzers SC-330 (Japan) which is an automatic instrument. TANITA is used to measure body composition especially when monitoring modest changes in fat [7]. The measurement was taken by asking the participants to stand barefoot and erect on the foot plate of the analyzer. TSTG and TSCH were measured by an institutionally qualified and well experienced technician with the use of BA-4545 semi-auto biochemistry analyzers (India).

2.4. Intervention
Participants were asked to gather in the hall, where fasting therapy was administered. To prepare and during fasting, the participants were kept away from daily routine to avoid interference by thoughts and emotions. The participants received 300-ml of LHJ (half lemon and a teaspoon of honey with 290-ml of water), 4-times (8.00–8.30-am, 11.30–12.00-am, 3.00–3.30-pm, and 6.30–7.00-pm) a day for four successive days of fasting [8]. The participants were staying together in allotted hall under observation from 6 am to 8 pm and then asked to go back to their residential hostel and kept under observation. We used Western Ghats of Karnataka (Dharmasthala) honey, which is dark yellow color multi-floral honey, has mixed flavor and aroma. Its physiochemical analysis was: pH = 3.48, ash (%) = 0.60, moisture (%) = 15.54, acidity (meq/kg) = 20.0, total sugar (%) = 75, protein (mg/g) = 0.80, phenol (mg/g) = 0.67, alkaloid (%) = 10.6. This honey was reported to have good quality and can be used in traditional medicine [9]. Drinking water (whenever thirsty) was allowed during the fasting period, and the participants were instructed to avoid any vigorous physical activities to avoid the risk of hypoglycemia [10]. On day-5, the fast was broken with 300-ml of sweet lime juice (morning) followed by fruit diet (papaya 200-g) at afternoon, raw diet (sprouts 50-g and raw vegetables 100-g, and fruit salad 100-g) at night, and normal routine boiled diet from the next day [8].

2.5. Data analysis
Data were statistically analyzed using SPSS for Windows, Version 16.0. Chicago, SPSS Inc. Descriptive analysis was done for demographic variables of the study group (n = 44) and sub-groups (male [n = 14] and female [n = 30]). Student’s paired samples t-test was performed to analyze baseline and post assessments of both study-group and sub-groups. P < 0.05 was considered as significant.

3. Results
Of 50 participants, 44 successfully completed the study. Data assessment was done before and after intervention. Demographic variables were age in years (both genders [20.68 ± 1.95], male [20.71 ± 1.59], female [20.67 ± 2.12]), and height in centimeters (both genders [162.43 ± 8.45], male [171.79 ± 6.74], female [158.07 ± 4.86]). Baseline and post assessments of study-group (n = 44) and sub-group (male [n = 14] and female [n = 30]) are in Tables 1 and 2, respectively.

Our study showed significant reduction in weight, BMI, fat mass (FM), free FM (FFM), muscle mass (MM), total body water (TBW), and TSTGs in study-group compared to baseline (Table 1). In sub-group analysis, significant reduction in weight, BMI, FFM, MM, TBW, and TSCH in females were observed similar to study group, whereas in males, significant reduction was observed only in weight, BMI, FFM, and MM (Table 1). Though there were no significant reductions in fat percentage and TSCH, a trend toward reduction was observed (Tables 1 and 2).

4. Discussion
Our study showed a significant reduction in weight, BMI, FFM, MM, TBW, and TSTG in study-group compared to baseline. Significant reduction in weight and BMI might attribute reduction of FM and FFM during fasting. Reduction in weight might possibly be due to LHJ as well, due to its Vitamin-C content, which was shown to have an association with weight loss [2]. Reduction in FM (significant) and fat% (insignificant) and TSTG (significant) compared to baseline indicates fat utilization during fasting because adipose tissue triglyceride mobilization during fasting is an important adaptive response and it is the major source of body’s energy during food deprivation. This result might be attributed to the effect of fasting on plasma insulin concentration which was reported to have an inverse correlation to antilipolytic activity in adipose tissue during fasting [11] or due to the effect of Vitamin-C, an essential factor for biosynthesis of carnitine, useful for subsequent fat oxidation by shuttling long chain fatty acids across the mitochondrial membrane [2] or due to the effect of honey, which has lipid-lowering property in normal and hyperlipidemic participants [6].

Significant reduction in FFM such as MM and TBW indicates the utilization of muscle tissues and body fluids for energy requirement during the latter period of fasting where normal food intake was restricted. Though normal food intake was restricted, none of the participants reported any adverse effects except mild tiredness and mild giddiness in few subjects, which indicates the safety of short-term LHJF among healthy individuals.

Table 1
Baseline and post assessment of study group (n = 44) (Students paired-t-test).

| Variables     | Baseline  | Post treatment | t       | P     |
|---------------|-----------|----------------|---------|-------|
| Weight (kg)   | 54.28 ± 12.93 | 52.11 ± 12.65 | 13.334  | <0.001|
| BMI (kg/m²)   | 20.46 ± 3.57  | 19.64 ± 3.54  | 11.749  | <0.001|
| Fat (%)       | 17.26 ± 8.30  | 16.99 ± 8.97  | 1.565   | 0.125 |
| FM (kg)       | 9.93 ± 7.46   | 9.33 ± 7.84   | 2.999   | <0.01 |
| FFM (kg)      | 44.35 ± 7.68  | 42.78 ± 7.30  | 6.337   | <0.001|
| MM (kg)       | 42.10 ± 7.32  | 40.60 ± 6.94  | 6.300   | <0.001|
| TBW (kg)      | 31.16 ± 6.08  | 30.09 ± 6.05  | 5.758   | <0.001|
| TSTG (mg/dL)  | 95.50 ± 30.65 | 78.18 ± 20.44 | 3.889   | <0.001|
| TSCH (mg/dL)  | 147.77 ± 24.91| 143.07 ± 23.63| 1.646   | 0.107 |

All values are as mean ± SD. BMI: Body mass index; FM: Fat mass; FFM: Free fat mass; MM: Muscle mass; TBW: Total body water; TSTG: Total serum triglycerides; TSCH: Total serum cholesterol; SD: Standard deviation.

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practice even at home. No serious adverse effect was found. The intervention might possibly be used as a preventive measure for the modern public health problems such as obesity, hypertriglyceridemia, etc. Further studies (randomized control trials) with the larger sample size are required to warrant these effects and to evaluate the mechanism behind the effect of LHJF on lipid profile and body compositions, in healthy as well as in various disease conditions.

### 5. Conclusion

The result of our study suggests that 4-day of LHJF may be considered as an effective and safe method in reducing body weight, BMI, FM, and TSTG in healthy individuals, which might be useful in prevention of obesity and hypertriglyceridemia.

### Source of support

Nil.

### Conflict of interest

None declared.

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### 4.1. Limitations of the study

We did not measure HDL, LDL to obtain complete lipid profile; hormones such as plasma insulin and norepinephrine, which are shown to play an important role in the lipolysis in various studies [11]. Due to the absence of a control group, the result of our study may not primarily be attributed to the effect of LHJ during fasting. Disproportionate number of males with that of females could be of the limitation.

### 4.2. Strengths of the study

Intervention is cost effective and short duration of the intervention makes it easily acceptable, adaptable, and feasible to