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Apple cider vinegar effervescent tablets on gut health, obesity and user experience – A randomized controlled trial

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Abstract

Research indicates that apple cider vinegar (ACV) may benefit health by lowering blood glucose, cholesterol, triglycerides, body weight, waist circumference, and BMI. To investigate further, a 60-day randomized controlled trial was conducted at Sudha Institute of Medical Science involving 77 participants with abnormal weight. They were divided into control and ACV groups. The ACV group consumed a daily ACV effervescent tablet, engaged in mild exercise, and followed a low-sugar diet, while the control group followed only the exercise and diet regimen. Anthropometric measurements and participant satisfaction data were collected throughout. The analysis revealed significant reductions in weight, BMI, waist and hip circumference, and waist-hip ratio over the 60-day period. Additionally, improvements were observed in abnormal food intake and various digestive issues such as appetite, constipation, cravings, and gas problems in the ACV group. Notably, 56.25% of control group participants and 44.44% of ACV group participants were categorized as overweight. Data analysis was conducted using Microsoft Excel, utilizing descriptive statistics such as mean and percentage. The study concluded that daily consumption of ACV effervescent tablets has a positive impact on weight loss and alleviates issues related to digestion and appetite. These findings underscore the potential benefits of incorporating ACV into dietary and lifestyle interventions for individuals with abnormal weight, suggesting its role as a complementary approach to promote overall health and well-being.

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INTRODUCTION

The World Health Organization (WHO) defines overweight as a BMI greater than or equal to 25 Kg/m^2 and obesity as a BMI greater than or equal to 30 Kg/m^2. Rates of overweight and obesity have been steadily rising, with a global increase in the prevalence of overweight or obese children and adolescents aged 5–19 from 4% to 18% between 1975 and 2016 [1]. India, with a population of 1.2 billion, is estimated to have around 350 million people affected by obesity [2]. The rise of obesity is

linked to non-communicable diseases (NCDs) such as diabetes, hypertension, dyslipidemia, and coronary heart disease [3][4]. In South Asian countries, including India, the obesity epidemic has emerged rapidly, with evidence indicating a higher risk for NCDs among those from the Indian subcontinent compared to Europeans [5]. Excessive white rice consumption and inadequate physical activity also contribute to abdominal fat deposition among South Asians [6][7]. Apple cider vinegar (ACV), a plant-based product containing acetic acid, pectin, potassium, and various polyphenol compounds, has been studied for its potential benefits [8][9]. Animal studies and clinical trials suggest that ACV may contribute to reducing blood glucose levels, total cholesterol, triglycerides, fasting blood glucose, low-density lipoprotein (LDL), HbA1C, body weight, waist circumference, and BMI [10][11].

A 15 years old boy reported with corrosive esophageal injury (destruction of the surface of upper gastrointestinal tract) after daily consumption of liquid vinegar daily [12]. A 15 years old girl noted with erosive tooth wear after consumption apple cider vinegar daily [13]. ACV liquid often presents the drawbacks of a sour and acidic taste, making it less palatable, less convenient to carry, and more susceptible to spills, especially when traveling. To address these challenges, ACV effervescent tablets are formulated with added flavors to enhance taste and overcome the issues of the liquid form. These tablets offer the advantage of a pre-determined dosage, simplifying intake for individuals. Consequently, ACV effervescent tablets are a more convenient option, providing a portable and flavorful alternative to traditional liquid ACV. This study aims to evaluate the effects of 60-day apple cider vinegar effervescent tablets consumption on anthropometric indices in individuals with abnormal weight.

AIM

This study aims to assess the impact of consuming apple cider vinegar effervescent tablets for 60 days on anthropometric indices among individuals with abnormal weight.

OBJECTIVES

- To analyze the impact of apple cider vinegar effervescent tablets on waist circumference, hip circumference, waist-hip ratio, body weight, and body mass index (BMI).
- To assess patient satisfaction regarding cravings, digestion, and appetite.
- To analyze the user experiences associated with the consumption of apple cider vinegar effervescent tablets.

METHODOLOGY

Study design – Randomized controlled trial

Product used – Apple cider vinegar effervescent tablets. Composition includes Pomegranate extract – 100mg, Apple cider vinegar – 700mg, Vitamin B12 – 1mcg, Vitamin B6 – 2mg and Beet root extract.

Study site – Data was collected from patients attending the outpatient of general medicine department at Sudha Institute of Medical Science in Erode, Tamil Nadu.

Sampling technique - Convenient sampling and those who consented.

Inclusion criteria - Individuals aged 18 to 60 with a BMI exceeding 25 kg/m^2 and patients diagnosed with lifestyle-related diseases such as diabetes mellitus and hyperlipidemia.

Exclusion criteria - Individuals taking four or more medications, those facing serious illnesses such as cancer or congestive cardiac failure, Non-consenters, those who have encountered heartburn attributed to vinegar, and special populations like pregnant and lactating women.

Ethical consideration- Registration number is ECR/948/Inst/TN/2023/RR-22. We got ethical approval from the Institutional Ethical Committee (IEC) at Sudha Institute of Medical Science.

Study procedure – A specially designed questionnaire was used to collect demographics, medical and medication history and the satisfaction levels. Anthropometric measurements were recorded by the researchers. The user satisfaction survey covered such as food intake and issues like digestion, constipation, cravings, and gas-related concerns. This trial comprised 77 participants with abnormal weight, divided into a control group and a test group (ACV group). In the ACV group, 45 individuals with abnormal weight ingested an Apple Cider Vinegar (ACV) effervescent tablet daily after lunch, engaged in

mild basic exercise, and adhered to a low-sugar diet for duration of 60 days. The control group, consisting of 32 participants with abnormal weight, followed a regimen of mild basic exercise and adhered to a low-sugar diet for the 60-day period. Anthropometric measurements and participant satisfaction and subjects ACV consumed experience data were collected from participants on the 0th day (Baseline), as well as on the 15th, 30th days, 45th day and 60th days during the data collection period and then compare the data between ACV group and control group. Anthropometric measurements, participant satisfaction data were collected from participants on the 0th day (baseline), as well as on the 15th, 30th, 45th, and 60th days during the data collection period. Subsequently, the data were compared between the ACV group and the control group. Subject's experiences with consumption of apple cider vinegar effervescent tablet were collected at the end of this trial.

Statistical analysis - The data was entered and analyzed in a Microsoft Excel spreadsheet. Descriptive statistics such as mean and percentage were derived. The data collected were analyzed using Jamovi 2.3.28 and ANOVA.

Table 1 Age distribution of participants

Age (in years)	Control		Test	
	Number of participants	Percentage of participants	Number of participants	Percentage of participants
18 – 30	14	43.75%	17	37.78%
31 – 40	7	21.88%	17	37.78%
41 – 50	4	12.5%	6	13.33%
51 – 60	4	12.5%	5	11.11%
61 – 70	3	9.37%	0	0%
Total	32	100%	45	100%
Mean age	37.09		35.49	

RESULT

A total of 77 participants, comprising 32 individuals in the control group and 45 individuals in the ACV group, were enrolled in this trial. **Table 1** illustrated that 60% of control group participants and 75% of ACV group participants fell within the age range of [10] to 40 years. The mean age for control group participants was 37.09 years, while for ACV group participants, it was 35.49 years. **Table 2** indicated that the study comprised 60% females in the ACV group and 71.88% males in the control group. **Table 3** Demonstrated that 56.25% of control group participants and 44.44% of ACV group participants were in the overweight category.

Table 4 illustrates a 3.21% decrease in average waist circumference, a 2.47% reduction in average hip circumference, a 1.05% decrease in average waist-hip ratio, a 5.29% drop in average body weight, and a 5.28% decrease in average BMI among individuals who consumed ACV and adhered to a mild basic exercise and diet regimen for 60 days. In contrast, the control group, which did not consume ACV but followed a similar exercise and diet routine, experienced an increase in all anthropometric measurements values, except for the average waist-hip ratio over the 60-day period. **Table 5** reveals a significant difference in all anthropometric measurements within the subjects, while no significant difference was observed in anthropometric measurements between the subjects after the 60-day trial period.

Table 6 indicates that after 60 days of consuming ACV, 75.56% of participants who initially perceived increased food intake reported a reduction in abnormal food intake. Additionally, 15.56% of participants with a history of improper digestion noted improvements after the 60th day of ACV consumption. Among those who experienced abnormal appetite (82.22% of participants), constipation (31.11%), gas crisis (11.11%), and cravings (86.67%), positive changes were observed after the 60-day period of ACV consumption. In contrast, the control group participants did not show any improvement in issues such as constipation, digestion, gas crisis, cravings, and appetite after the same 60-day period. Very few percentage of participants felt stomach irritation.

Table 2 Gender distribution of participants

Gender	Control		Test	
	Number of participants	Percentage of participants	Number of participants	Percentage of participants
Male	23	71.88%	18	40%
Female	9	28.12%	27	60%
Total	32	100%	45	100%

Table 3 BMI based participant classification

BMI Classification	Control		Test	
	Number of participants	Percentage of participants	Number of participants	Percentage of participants
Overweight	18	56.25%	20	44.44%
Obese class 1	10	31.25%	16	35.56%
Obese class 2	3	9.37%	7	15.56%
Severe obesity	1	3.13%	2	4.44%
Total	32	100%	45	100%

Table 4 Variations in anthropometric measurements among the test and control groups

Measurements	Number of days	Test	Percentage differences (Baseline to 60th day)	Control	Percentage differences (Baseline to 60th day)
Waist length (cm)	0th day	99.12	-3.21%	94.92	+0.24%
	15th day	98.67		95.07	
	30th day	97.99		95.13	
	45th day	97.25		95.13	
	60th day	95.94		95.15	
Hip length (cm)	0th day	104.27	-2.47%	101.41	+1.25%
	15th day	103.93		101.89	
	30th day	103.20		102.25	
	45th day	102.54		102.57	
	60th day	101.69		102.68	
Waist - Hip ratio	0th day	0.95	-1.05%	0.94	-1.06%
	15th day	0.95		0.93	
	30th day	0.95		0.93	
	45th day	0.95		0.93	
	60th day	0.94		0.93	
Weight (kg)	0th day	78.9	-5.29%	77.66	+1.38%
	15th day	78.27		77.78	
	30th day	77.44		78.03	
	45th day	76.11		78.32	
	60th day	74.73		78.73	
BMI (kg/m^2)	0th day	31.09	-5.28%	29.88	+1.41%
	15th day	30.84		29.93	
	30th day	30.51		30.02	
	45th day	29.99		30.14	
	60th day	29.45		30.30	

Table 5 Waist circumference within and between subjects

Anthropometric measurements	Subjects category	Measurement	Sum of Squares	Df	Mean Square	F	P	η^2_p
	Within the subjects	Waist	345	4	86.2	3.48	0.009*	0.05
Waist circumference		Waist ✻ Group	348	4	87	3.51	0.008*	0.051
	Between the subjects	Group	831	1	831	1.41	0.24	0.021
Hip circumference	Within the subjects	HIP	26.5	4	6.64	3.92	0.004*	0.055
		HIP ✻ Group	153.1	4	38.27	22.62	< 0.001*	0.252
	Between the subjects	Group	314	1	314	0.652	0.422	0.01
Waist (W) – Hip (H) ratio	Within the subjects	W – H	0.0114	4	0.00284	1.23	0.299	-
		W - H ✻ Group	0.0148	4	0.0037	1.6	0.174	-
	Between the subjects	Group	7.05E-04	1	7.05E-04	0.0377	0.847	-
Weight	Within the subjects	Weight	123	4	30.681	51.4	< .001*	0.431
		Weight ✻ Group	301	4	75.341	126.3	< .001*	0.65
	Between the subjects	Group	27.6	1	27.6	0.0333	0.856	0
BMI	Within the subjects	BMI	18.2	4	4.5489	51.8	< .001*	0.432
		BMI ✻ Group	47	4	11.759	134	< .001*	0.663
	Between the subjects	Group	15.4	1	15.4	0.203	0.654	0.003

* - Significant difference

Table 6 Participants satisfaction questionnaires

Questions	Number of days	Control		Test	
		Number of participants	Percentage of participants	Number of participants	Percentage of participants
Abnormal food intake	0th day	25	78.13%	34	75.56%
	60th day	25	78.13%	0	0%
Improper digestion	0th day	17	53.13%	7	15.56%
	60th day	17	53.13%	0	0%
Abnormal appetite	0th day	12	37.5%	37	82.22%
	60th day	12	37.5%	0	0%
Constipation problem	0th day	15	46.88%	14	31.11%
	60th day	15	46.88%	0	0%
Gas crisis problem	0th day	20	62.5%	27	60%
	60th day	20	62.5%	0	0%
Craving problem	0th day	26	81.25%	39	86.67%
	60th day	26	81.25%	0	0%

Table 7 User's experience on consumption of ACV effervescent tablet

User's experience about Apple cider vinegar effervescent tablet intake	Answer	Number of participants	Percentage of participants
Frequency of apple cider vinegar effervescent tablet intake	Daily once	45	100%
	Few times a week	0	0%
	Occasionally	0	0%
		0	0%
How long have you taking apple cider vinegar effervescent tablet?	Less than a month	3	6.67%
	1 - 2 months	5	11.11%
	2 - 4 months	37	82.22%
Benefits of apple cider vinegar effervescent tablet	Both weight loss and improved digestion	45	100%
	Increased energy level	0	0%
How you consume apple cider vinegar effervescent tablet?	Dissolve the tablet in water and drink	45	100%
	Chewing the tablet	0	0%
	Shallow the tablet	0	0%
Did you follow any specific dosage instruction?	Yes	43	95.6%
	No	2	4.4%
Have you tried other forms of apple cider vinegar effervescent tablet?	Yes	0	0%
	No	45	100%
Taste of blubein apple cider vinegar effervescent tablet	Very satisfied	21	46.7%
	Satisfied	8	17.8%
	Neutral	4	8.9%
	Dissatisfied	11	24.4%
	Very dissatisfied	1	2.2%
Any changes in your health since taking apple cider vinegar effervescent tablet?	Yes	38	84.4%
	No	2	4.4%
	Unsure	5	11.1%
Would you recommend apple cider vinegar effervescent tablet?	Yes	43	95.6%
	No	0	0%
	Yet not decided	2	4.4%
Are you going to the gym while using apple cider vinegar effervescent tablet?	Yes	34	75.6%
	No	11	24.4%
Rate for blubein apple cider vinegar effervescent tablet	Good (8-10)	36	80%
	Average (5 – 7)	9	20%
	Bad (1- 4)	0	0%

Table 7 demonstrates that all subjects consumed ACV effervescent tablets on a daily basis throughout the study. 82.22% of participants used ACV for 2-4 months. 100% of participants consumed ACV effervescent tablets by dissolving the tablet in water and drinking it, experiencing benefits such as weight loss and improved digestion. None of the participants ever used other forms of ACV. 95.6% of participants followed all instructions provided by the researcher regarding ACV consumption. 64.5% of participants were satisfied with the taste of ACV effervescent tablets. 84.4% of participants noticed changes in their health after consuming ACV effervescent tablets. 95.6% of participants would recommend ACV effervescent tablets for weight loss and addressing issues like cravings, appetite, constipation, and digestion to their colleagues and neighbors. 80% of participants rated blubein ACV effervescent tablets as good.

DISCUSSION

Apple cider vinegar (ACV) is produced by fermenting apples. This acidic solution is consumed throughout the world as a flavoring and

preservative agent in foods. ACV contains a variety of flavonoids, such as gallic acid, catechin, caffeic acid, and ferulic acid. Some experiments have reported that ACV has a variety of pharmacological functions, including anti-oxidant, anti-inflammatory, anti-diabetic, anti-hypertensive and anti-hyperlipidemic properties. Apple cider vinegar also used for reduces weight.

This study comprised of 60% females in the ACV group and 71.88% males in the control group. This study comprised 56.25% of control group participants and 44.44% of ACV group participants were in the overweight category. The WHO report indicates a prevalence of overweight at 38%, with 9% among men and 40% among women, while obesity prevalence stands at 13%, with 11% among men and 15% among women in adults aged 18 years and above [14].

The results of this study indicate a reduction in weight, BMI, waist circumference, hip circumference, and waist-hip ratio over a 60days period. In a study conducted by Kondo et al. in 2009, a double-blind study conducted in obese Japanese individuals noted a reduction in BMI, body weight, waist circumference, hip circumference, and waist-hip ratio among those who consumed vinegar over a 12-week period [18].

The findings of this study shows that significant difference in all anthropometric measurements within the subjects, while no significant difference was observed in anthropometric measurements between the subjects over a 60days period. Khalid et al. (2020) conducted a randomized controlled trial examining the impact of apple cider vinegar (ACV) on weight management, blood glucose levels, and lipid profile among overweight adults. They found a significant difference ($P = 0.000$) in BMI between the control and case groups over a 60-day period [16]. Jafarirad et al. (2023) also conducted a randomized controlled trial focusing on the effects of ACV consumption on anthropometric indices in Type 2 diabetes mellitus (T2DM) patients. They observed a significant difference ($P < 0.001$) in various anthropometric indices such as weight, BMI, waist circumference, and hip circumference between the two groups after 8 weeks, although no significant difference was found in waist-to-hip ratio [15].

During the 60-day study period, participants reported decreased appetite, lower food consumption, and improvement in digestive issues such as constipation and gas, leading to increased satisfaction with ACV effervescent tablet. Hlebowicz et al. (2007) conducted a pilot study and concluded that individuals who consumed apple cider vinegar exhibited delayed gastric emptying [17]. Apple cider vinegar (ACV) has the potential to improve glycemic status through several mechanisms, such as delaying gastric emptying, enhancing cellular glucose utilization and lipolysis, suppressing hepatic glucose production and lipogenesis, and promoting insulin secretion [10]. According to a study conducted by Hjorth et al. in 2020, ACV was found to alleviate constipation issues experienced by patients with schizophrenia who were undergoing treatment with clozapine [19].

CONCLUSION

Consumption of apple cider vinegar effervescent tablets led to a reduction in waist circumference, hip circumference, waist-hip ratio, weight, and BMI. Apple cider vinegar effervescent tablets were observed to reduce appetite, lower food intake, and resolve issues such as digestion problems, constipation, gas-related concerns, and cravings over a 60-day period.

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Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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