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Review Article

An Evidence-Based Review of Fat Modifying Supplemental Weight Loss Products

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Objective. To review the literature on fat modifying dietary supplements commonly used for weight loss. *Methods*. Recently published randomized, placebo-controlled trials were identified in PubMed, MEDLINE, *International Pharmaceutical Abstracts*, Cochrane Database, and Google Scholar using the search terms dietary supplement, herbal, weight loss, obesity, and individual supplement names. *Discussion*. Data for conjugated linoleic acid (CLA), *Garcinia cambogia*, chitosan, pyruvate, *Irvingia gabonensis*, and chia seed for weight loss were identified. CLA, chitosan, pyruvate, and *Irvingia gabonensis* appeared to be effective in weight loss via fat modifying mechanisms. However, the data on the use of these products is limited. *Conclusion*. Many obese people use dietary supplements for weight loss. To date, there is little clinical evidence to support their use. More data is necessary to determine the efficacy and safety of these supplements. Healthcare providers should assist patients in weighing the risks and benefits of dietary supplement use for weight loss.

1. Introduction

The prevalence of obesity has continued to increase over the last several years in the United States. Per the National Health and Nutrition Examination Survey (NHANES) for the 2007-2008 year, the prevalence of obesity, defined as a body mass index (BMI) $\geq 30\,kg/m^2$, among adults was greater than 30% and those who were overweight or obese (BMI $\geq 25\,kg/m^2$) was almost 70% for both men and women. The trend over the past 20 years has shown an increase in the prevalence of obesity of six to seven percent every 10 years [1]. In addition, health care costs are approximately 42% higher for obese patients when compared to normal-weight patients [2].

Dietary supplements for weight loss are marketed to offer patients improved success that is faster and easier than calorie reduction and increased exercise. Despite concerns with efficacy and safety, these products continue to be an appealing alternative or adjunct to weight management [3, 4]. A national survey published in 2008 found that 33.9% of adults who have made a weight loss attempt had used a dietary supplement to do so. It was also found that the use was more common among women, younger adults, minorities, and those with less education and lower incomes [5]. Reasons why patients may opt for dietary supplements include the perception that they are "natural" and perhaps safer than prescription medications. In addition, patients often do not perceive a need to seek the assistance of a healthcare professional with these alternative therapies, and they also may be an alternative to previously failed attempts with conventional approaches [6].

Despite widespread use, there is still limited data on the safety and efficacy of the products currently on the market. Because dietary supplements are viewed as food and not drugs, they are not regulated by the Food and Drug Administration (FDA). Instead, under the Dietary Supplement Health and Education Act (DSHEA), dietary supplements can be marketed without evidence to support efficacy and safety. If a dietary supplement appears to be

unsafe after being marketed, the FDA can then decide whether or not to have the product removed from the market. This was the case for the weight loss supplement ephedra which was removed from the market in 2004 after reports of serious health risks [5]. The literature published in the arena of weight loss continues to be plagued by concerns such as: small studies, inconsistency with participant body weight (BMI), variation in length of studies, use of exercise, and a variety of products at differing dosages.

Several mechanisms are proposed to differentiate how these products work. These include products that claim to be: fat blockers, lipotropics or fat busters, thermogenic or energy modifiers, and products that can change carbohydrate metabolism, water elimination, or the feeling of satiety or fullness. The purpose of this paper is to review the literature on dietary supplements currently being marketed and promoted for weight loss via the mechanisms of altered fat absorption, fat metabolism and/or the storage of fat.

2. Methods

Published articles and abstracts were identified using PubMed, MEDLINE, *International Pharmaceutical Abstracts,* Cochrane Database, and Google Scholar with the search terms dietary supplement, herbal, weight loss, obesity, and by using individual supplement names. The primary emphasis was on pertinent articles based on human trials involving overweight subjects that were performed in a randomized and placebo-controlled process. Additional articles were identified from the references of the retrieved literature. Only studies that tested single dietary supplement products were included in this paper. Studies which included multiple products were not included due to inconclusive evidence of the effectiveness of individual products.

2.1. Fat Modifying Supplemental Weight Loss Products. Table 1 summarizes the data for the following fat modifying supplemental weight loss products.

2.1.1. Conjugated Linoleic Acid. Conjugated linoleic acid (CLA) is a naturally occurring fatty acid that is found in beef and dairy products [7]. Studies conducted in animals have shown that CLA is effective in reducing body fat mass, increasing insulin sensitivity, decreasing plasma glucose levels, is anticarcinogenic, and may have positive effects on atherosclerosis [8]. Conjugated linoleic acid has been indicated for the use in cancer, diabetes, hypertension, and hypercholesterolemia, as well as weight loss and body fat reduction. In regards to weight loss, CLA is believed to work by promoting apoptosis in adipose tissue. Many animal studies have shown CLA to be effective in weight loss and body fat reduction. This information has led to an increased interest as to whether or not CLA would have the same effects in humans [7].

Blankson et al. [9] performed a randomized, double-blind, placebo-controlled trial in which 52 patients (35 women and 17 men) with a BMI between 25 to 35 kg/m^2 were randomized to receive CLA 1.7, 3.4, 5.1, or 6.8 grams per day or placebo (9 grams of olive oil) for 12 weeks. At the end of 12 weeks, the results demonstrated a decrease in body fat mass (BFM) of 1.73 kg in the group receiving CLA 3.4 grams ($P \leq .05$) and a decrease of 1.3 kg in the group receiving 6.8 grams ($P \leq .05$). There were no statistical differences seen in body mass, BMI, or lean body mass (LBM). The most common adverse effects reported were gastrointestinal effects [9].

In a double-blind, placebo-controlled study performed by Risérus et al. [10], 24 men with an average baseline BMI of 32 kg/m^2 were randomized to receive either CLA 4.2 grams per day or placebo for 4 weeks. Along with other weight related endpoints, this study also evaluated the effects of CLA on sagittal abdominal diameter (SAD) as abdominal obesity has been linked with the metabolic syndrome. At the end of the study period, it was found that there was a significant decrease in SAD (−0.57 cm, $P = .04$). However, there was no difference seen in body weight or BMI. There were no adverse events reported [10].

A randomized, double-blind, placebo-controlled study by Smedman and Vessby [11] evaluated the effects of CLA 4.2 grams per day versus placebo for 12 weeks on percent body fat, body weight, BMI, and SAD in 50 patients (25 men and 25 women) with an average BMI of 25 kg/m^2. The results showed a 3.8% decrease in body fat in those receiving CLA ($P = .05$). There was no change seen in body weight, BMI, and SAD. CLA was well tolerated by all participants [11].

CLA is marketed as either a triacylglycerol or free fatty acid (FFA). Gaullier et al. [8] decided to not only evaluate the effectiveness of CLA on weight loss, but to see if either CLA-triacylglycerol or CLA-FFA is more efficacious than the other. This was a double-blind, placebo-controlled trial in which 180 patients (31 men and 149 women) with an average BMI of 28 kg/m^2 were randomized to receive 4.5 grams of olive oil (placebo), 4.5 grams 80% CLA-FFA, or 4.5 grams 76% CLA-triacylglycerol for 12 months. The results demonstrated a significant decrease in BFM in both the CLA-FFA and CLA-triacylglycerol groups compared to placebo (−1.7 and −2.4, resp.; $P < .05$). In the CLA-triacylglycerol group, there was also a significant decrease in body weight (−1.8 kg versus 0.2 kg; $P < .05$) and BMI (−0.6 kg/m^2 versus 1.8 kg/m^2; $P < .05$) when compared with placebo. The CLA-FFA group demonstrated an increase in LBM (2.0 kg versus 0; $P < .05$). All adverse events reported were rated as "mild" or "moderate" with the most common being gastrointestinal side effects [8].

Of the 180 participants of this study, 134 continued on in an open-label study for another 12 months. All participants remained in their original treatment arm, but all were treated with 4.5 grams daily of CLA-triacylglycerol for the remaining 12 months. While there was no additional decrease in body weight or BFM, this study did demonstrate that participants were able to maintain their weight loss. While two patients were observed to have an increase in aspartate amino transferase (ASAT), these levels returned to normal once CLA was discontinued ($P = .002$, CLA-FFA; $P = .009$, CLA-triacylglycerol). Overall, this study demonstrated that CLA use is safe over 24 months and may be beneficial in initial weight loss and may help with

Table 1: Summary data of fat modifying supplemental weight loss products.

Dietary Supplement	Trial	Average BMI (kg/m^2)	Treatment	Length of Treatment	Results
Conjugated linoleic acid	Blankson et al. [9]	25–35	CLA 1.7, 3.4, 5.1, or 6.8 grams/day or placebo	12 weeks	↓ BFM with CLA 3.4 grams (−1.73 kg, $P = .05$) and 6.8 grams (−1.3 kg, $P = .02$). No differences in body weight or BMI
	Risérus et al. [10]	32	CLA 4.2 grams/day or placebo	4 weeks	↓ SAD in CLA group (−0.57 cm, $P = .04$). No difference in body weight or BMI
	Smedman and Vessby [11]	25	CLA 4.2 grams/day or placebo	12 weeks	↓ % body fat in CLA group (−3.8%, $P = .05$). No change in body weight or BMI
	Gaullier et al. [8]	28	4.5 grams/day of CLA-FFA, 4.5 grams/day of CLA-triacylglycerol, or placebo	12 months	↓ BFM with CLA-triacylglycerol and CLA-FFA groups (−1.7 and −2.4 kg, resp.; $P < .05$) ↓ Body weight with CLA-triacylglycerol (−1.8 kg, $P < .05$) ↓ BMI with CLA-triacylglycerol (−0.6 kg/m^2, $P < .05$) ↑ LBM with CLA-FFA (2.0 kg, $P < .05$)
	Gaullier et al. [12]	28	4.5 grams/day of CLA-FFA, 4.5 grams/day of CLA-triacylglycerol, or placebo	24 months	No additional ↓ body weight or BFM
Garcinia cambogia (Hydroxycitric acid)	Heymsfield et al. [13]	32	*Garcinia cambogia* 3000 mg/day (1500 mg of HCA) or placebo	12 weeks	Both groups demonstrated weight loss and decrease in percent body fat; there was no difference between the groups
	Mattes and Bormann [14]	NR	*Garcinia cambogia* 2.4 g/day (1.2 g of HCA) or placebo		↓ 3.7 kg with *Garcinia cambogia* versus ↓ 2.4 kg with placebo
Chitosan	Pittler et al. [15]	26	Chitosan 1 gram, or placebo twice daily	28 days	No difference between groups in regards to body weight or BMI
	Schiller et al. [16]	32	Chitosan 1500 mg or placebo twice daily	8 weeks	↓ Body weight of 1 kg with chitosan ($P < .005$) ↓ BMI of 0.3 kg/m^2 with chitosan ($P < .01$) ↑Body weight of 1.5 kg with placebo ($P < .001$) ↑ BMI of 0.6 kg/m^2 with placebo ($P < .01$)
	Ni Mhurchu et al. [17]	35–36	Chitosan 3 grams/day or placebo	24 weeks	Chitosan group lost 0.39 kg versus a weight gain of 0.17 kg in the placebo group ($P = .03$)
	Kaats et al. [18]	NR	Chitosan 3 grams/day with behavior modification; placebo with behavior modification; or minimal intervention control	60 days	↓ Body weight of 2.8 lbs. with chitosan versus placebo ($P = .03$) ↓ Percent body fat of 0.8% with chitosan versus placebo ($P = .003$) ↓ Fat mass of 2.6 lbs. with chitosan versus placebo ($P = .001$) ↑ BCI of 2.4 lbs. with chitosan versus placebo ($P = .002$)

Table 1: Continued.

Dietary Supplement	Trial	Average BMI (kg/m^2)	Treatment	Length of Treatment	Results
Pyruvate	Stanko et al. [19]	27.8–52.7	Pyruvate 30 grams/day and calcium pyruvate 16 grams/day, or placebo	21 days	↓ 0.22 kg with pyruvate versus ↓ 0.17 kg with placebo ($P < .05$) ↓ BMI 2.2 kg/m^2 with pyruvate versus ↓ 1.5 kg/m^2 with placebo ($P < .05$) ↓ Fat 7.3% with pyruvate versus ↓ 5.4% with placebo ($P < .05$)
	Kalman et al. [20]	>25	Pyruvate 6 grams/day, placebo or nothing (control)	6 weeks	↑ LBM 2.4% with pyruvate ($P = .001$) ↓ Fat mass 12.2% with pyruvate ($P < .001$), and ↓ Body fat 12.4% with pyruvate ($P < .001$)
	Kalman et al. [21]	>25	Pyruvate 6 grams/day, or placebo	6 weeks	↓ Body weight 1.6% with pyruvate ($P < .001$) ↓ Body fat 14% with pyruvate ($P < .001$) ↓ % body fat 11.7% with pyruvate ($P < .001$)
Irvingia gabonensis	Ngondi et al. [22]	NR	*Irvingia gabonensis* 350 mg/day, or placebo	4 weeks	↓ Body weight 5.6% with *Irvingia gabonensis* ($P < .0001$) ↓ Waist circumference 5.07% with *Irvingia gabonensis* ($P < .0001$) ↓ Hip circumference 3.42% with *Irvingia gabonensis* ($P < .0001$)
	Ngondi et al. [23]	26–40	*Irvingia gabonensis* 150 mg/day, or placebo	10 weeks	↓ Body weight 12.8 kg with *Irvingia gabonensis* ($P < .01$) ↓ Waist circumference 16.19 cm with *Irvingia gabonensis* ($P < .01$) ↓ % body fat 6.3% with *Irvingia gabonensis* ($P < .05$)
Chia seeds (*Salvia hispanica*)	Nieman et al. [24]	NR	Chia seeds 50 g/day, or placebo	12 weeks	No differences in body mass or body composition

BCI: Body Composition Improvement, BFM: Body Fat Mass, BMI: Body Mass Index, CLA: Conjugated Linoleic Acid, FFA: Free Fatty Acid, HCA: Hydroxycitric Acid, LBM: Lean Body Mass, NR: Not Reported, SAD: Sagittal Abdominal Diameter.

maintaining weight loss and reductions in BFM. The most commons adverse events reported were gastrointestinal [12].

Studies reviewed indicate that CLA appears to be safe with the most common adverse effects being gastrointestinal (GI). Overall, it appears as though that CLA helps to reduce BFM and SAD in patients, but minimal effect on BMI or body weight. In addition, CLA may be beneficial in helping to maintain changes in body composition such as reductions in BFM.

2.1.2. Garcinia cambogia (Hydroxycitric Acid). Hydroxycitric acid (HCA) is the active ingredient found in the fruit of the *Garcinia cambogia* plant [25]. It is believed that hydroxycitric acid aids in weight loss by inhibiting lipogenesis by inhibiting the adenosine triphosphate (ATP)-citrate-lyase enzyme which is responsible for converting citrate to acetyl-coenzyme A and ultimately fatty acid synthesis. It is also theorized that HCA may improve exercise endurance by increasing lipid oxidation and decreasing carbohydrate metabolism and stimulate appetite suppression [13, 25].

Heymsfield et al. [13] performed a randomized, double-blind, placebo-controlled trial to measure the effects of HCA on body weight change and fat mass. The 135 participants (19 men and 116 women) with an average BMI of 32 kg/m^2 were randomized to receive 3000 mg of *Garcinia cambogia* (1500 mg of HCA) per day or placebo along with a high fiber, low-calorie diet for 12 weeks. The placebo group lost 4.1 kg, and the HCA group lost 3.2 kg. While the results within each separate treatment arm was significant when compared to baseline, there were no differences between the groups ($P = .14$). In addition, the placebo group demonstrated a decrease in percent body fat mass of 2.16%, and the HCA group demonstrated a 1.44% decrease. Again, there were no differences between the groups ($P = .08$). The most commonly reported adverse events were headache, upper respiratory tract symptoms, and gastrointestinal symptoms.

However, there were no differences between the HCA group and placebo [13].

A double-blind, placebo-controlled parallel group study performed by Mattes and Bormann [14] enrolled 89 mildly overweight females to evaluate HCA on weight loss and appetite suppression. The participants were randomized to receive 2.4 grams of *Garcinia cambogia* (1.2 grams of HCA) or placebo per day, in addition to a low calorie diet. At the end of 12 weeks, it was noted that the HCA group lost significantly more weight than the placebo group (3.7 ± 3.1 kg versus 2.4 ± 2.9 kg). There were no changes on appetitive variables [14, 26].

While HCA appears to be well tolerated, there is limited data with regards to its efficacy. The data that is available, however, does not demonstrate significant weight loss. Therefore, *Garcinia cambogia* or HCA is not recommended at this time.

2.1.3. Chitosan. Chitosan is a form of chitin that comes from the shells of crustaceans such as shrimp, lobster, and crab. Several *in vitro* studies have shown that chitosan binds dietary fats and bile acids. Because of this proposed mechanism of action, it is theorized that chitosan may be useful for weight control, as well as for a treatment of hypercholesterolemia [15–18, 27, 28].

A randomized, double-blind placebo-controlled trial performed by Pittler et al. [15] examined the effects of chitosan on weight loss. Thirty-four patients (6 men and 28 women) with a BMI of approximately 26 kg/m^2 were randomized to receive one gram chitosan or placebo twice daily for 28 days. At the end of the study period, there was no difference in body weight or BMI between the two groups. Adverse effects reported with chitosan were minor. The most common complaint was constipation [15].

Schiller et al. [16] evaluated the use of rapidly soluble chitosan in weight loss and reducing body fat in 59 participants with an average BMI of 32 kg/m^2 consuming a high fat diet. In this double-blind, placebo-controlled trial, the participants were randomized to receive 1500 mg of chitosan or placebo twice a day with the largest meals of the day for eight weeks. At the end of the study period, patients in the chitosan group lost 1 kg ($P < .005$), and the BMI was significantly decreased by 0.3 kg/m^2 ($P < .01$). Patients in the placebo group gained 1.5 kg ($P < .001$), and the BMI was significantly higher by 0.6 kg/m^2 ($P < .01$). When treatment was compared to placebo, weight and BMI were significantly higher in the placebo group ($P < .0001$ and $P < .05$, resp.). The most common adverse effects reported were gastrointestinal, flatulence, increased stool bulkiness, bloating, nausea, and heartburn. This study demonstrated that chitosan may be an effective weight loss supplement [16].

Ni Mhurchu et al. [17] evaluated the effects of chitosan on 250 patients (44 men and 206 women) with a BMI 35 to 36 kg/m^2. This double-blind, placebo-controlled trial randomized patients to receive three grams of chitosan per day or placebo in addition to receiving standardized dietary and lifestyle advice. The trial was conducted over 24 weeks. At the end of the study period, the chitosan group lost more weight than placebo (-0.39 versus $+0.17$ kg, $P = .03$). There were ten serious adverse events, four of which occurred in the chitosan group. These included three hospitalizations and one cancer incidence. Thirty-six participants in the chitosan group reported some minor adverse events which were primarily gastrointestinal related [17].

In a randomized, double-blind, placebo-controlled trial by Kaats et al. [18], 150 overweight adults were randomized to three study groups: three grams of chitosan per day and a behavior modification program, placebo and a behavior modification program, or a minimum intervention control group. The trial was conducted over 60 days. At the end of the study period, participants in the chitosan group demonstrated a significant reduction in weight compared to control (-2.8 versus $+0.8$ pounds, $P < .001$) and a decrease in fat mass compared to control ($P = .006$). When compared to placebo, the chitosan group demonstrated a decrease in weight (-2.8 versus -0.6 pounds, $P = .03$), a decrease in percent fat ($-.08\%$ versus $+0.4\%$, $P = .003$), a decrease in fat mass (-2.6 versus $+0.6$ pounds, $P = .001$), and an increase in body composition improvement (BCI) ($+2.4$ versus -1.9 pounds, $P = .002$) [18].

Chitosan is well tolerated with the most common adverse effects being gastrointestinal. Based on the above studies, it appears as though chitosan may be effective to help aid weight loss. Because of limited data thus far, chitosan cannot be recommended at this time. Chitosan, however should be avoided in individuals with a shellfish allergy [27].

2.1.4. Pyruvate. Pyruvate is a three-carbon compound that is a byproduct of glucose metabolism. It is unclear how pyruvate works to promote weight loss, but in rats a lower respiratory exchange ratio has been demonstrated indicating that there was increased utilization of fat and an elevation in resting metabolic rate [21, 29].

Stanko et al. and Kalman et al. both performed several studies evaluating the use of pyruvate in weight loss [19–21]. The study performed by Stanko et al. [19] was a double-blind, placebo-controlled trial which evaluated body composition with a low energy diet and supplementation with pyruvate. Fourteen women with a BMI 27.8 to 52.7 kg/m^2 were placed on a low energy diet and then randomly assigned to receive either 30 grams of pyruvate plus 16 grams of calcium pyruvate per day or placebo for 21 days. The pyruvate group lost 0.22 kg compared to 0.17 kg in the placebo group ($P < .05$), and there was also a decrease in BMI of 2.2 kg/m^2 compared to 1.5 kg/m^2 in the placebo group ($P < .05$). In addition, the pyruvate group lost 7.3% fat versus 5.4% in the placebo group ($P < .05$) [19].

In the first study by Kalman et al. [20] a randomized, double-masked, placebo-controlled trial was performed in which participants received six grams/day of pyruvate, placebo, or nothing (control group) along with diet and exercise counseling. The 51 participants (25 men, 26 women) enrolled had a BMI greater than 25 kg/m^2. At the end of six weeks, fat mass decreased significantly (-12.2%; $P < .001$), percent body fat decreased significantly (-12.4%; $P < .001$), and lean body mass increased ($+2.4\%$; $P = .001$) in the pyruvate group when compared to baseline. The placebo and

control groups did not demonstrate any significant changes in fat mass, percent body mass, and lean body mass [20].

Kalman et al. [21] performed another six week, double-blind, placebo-controlled trial. Twenty-six subjects (10 men, 16 women) with a BMI greater than 25 kg/m^2 were randomly assigned to receive six grams of pyruvate per day or placebo. At the end of the trial, there was a 1.6% decrease in body weight ($P < .001$), a 14% decrease in body fat ($P < .001$), and an 11.7% decrease in percent body fat ($P < .001$) in the pyruvate group. There were no significant changes in the placebo group [21].

In studies published thus far, pyruvate has demonstrated that it may be beneficial for weight loss. In addition, it tends to be well tolerated with minimal adverse effects. The most common adverse effect is gastrointestinal upset [29]. However, the trials conducted so far have had small sample sizes and have only been performed for short periods of time. Although it appears to be safe, there is no data on the long term use of pyruvate.

2.1.5. Irvingia Gabonensis. *Irvingia gabonensis* is a mango-like fruit that comes from the deciduous forest tree found in West Africa [22, 30]. It is theorized that *Irvingia gabonensis* works by inhibiting adipogenesis by down-regulating peroxisome proliferator-activated receptor gamma (PPAR-gamma) which is responsible for the differentiation of adipocytes. In addition, it also observed that adiponectin levels increase and leptin levels decrease in patients given *Irvingia gabonensis*. *Irvingia gabonensis* has also been used to treat hypercholesterolemia [30].

The first trial was performed by Ngondi et al. in 2005. This was a randomized, double-blind, placebo-controlled trial that enrolled 40 obese subjects in Cameroon. Subjects were randomly assigned to receive 350 mg of *Irvingia gabonensis* seed extract or placebo for 4 weeks. At the end of the 4 weeks, the *Irvingia gabonensis* group was observed to have a decrease in body weight of 5.6 ± 2.7% ($P < .0001$), a decrease in waist circumference of 5.07 ± 3.18% ($P < .0001$), and a decrease in hip circumference of 3.42 ± 2.12% ($P < .0001$). The placebo group observed a decrease in body weight of 1.32 ± 0.41%. There was no change in percent body fat for both the treatment and placebo groups [22].

A second article by Ngondi et al. [23] also examined the effects of *Irvingia gabonensis* on weight loss. This was a double-blind, placebo-controlled trial in which 102 natives of Cameroon with a BMI of 26 to 40 kg/m^2 were randomized to receive 150 mg of *Irvingia gabonensis* or placebo daily for ten weeks. At the end of the study period, there was a significant difference between the treatment group and placebo for body weight (−12.8 kg versus −0.7 kg; $P < .01$), waist circumference (−16.19 cm versus −5.3 cm; $P < .01$), and percent body fat (−6.3% versus −1.99%; $P < .05$) [23].

Although the current data looks encouraging, to date there is limited data on the use if *Irvingia gabonensis* in weight loss. It appears to be safe and well tolerated as the most common adverse effects are headache, flatulence, and difficulty sleeping [30]. Due to the limited data, *Irvingia gabonensis* cannot be recommended at this time.

2.1.6. Chia Seed (Salvia hispanica). Chia seed, or *Salvia hispanica*, is a sprout that has high concentrations of omega-3-fatty acids, alpha-linoleic acid, and fiber [24, 31]. It has been hypothesized that these components of the seeds would not only help with diseases such as hypercholesterolemia or diabetes, but that it may also be beneficial in weight loss. Nieman et al. [24] performed a single-blinded, trial in which 76 overweight/obese participants were randomized to receive 50 grams of chia seed daily or placebo. At the end of 12 weeks, it was noted that there were differences pre- and poststudy on body mass or body composition [24]. While considered safe in the short term, there is limited data to suggest the use of chia seeds for weight loss.

3. Conclusion

Because the prevalence of obesity in the United States is significant, many people turn to the use of supplemental products as an assist with weight loss efforts. While there are several dietary supplements being marketed for the use in weight loss via several different mechanisms of action, there is very little clinical evidence to support their use. Conjugated linoleic acid, pyruvate, and *Irvingia gabonensis* have shown some potential benefit for weight loss. However, more data is necessary to draw any definitive conclusions on the use of dietary supplements for weight loss. Continued research is needed in this area to aid health care providers as well as the public in general. Health care providers should be aware of the weight loss products available to their patients and assist patients in determining the risks and benefits of supplement use for weight loss.

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