# Anti-arthritic Effect of Fig and Avocado Combined with Olive Oil on Disease Activity and Immune Status of Osteoarthritic Patients

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## Abstract

An intervention case-control study aimed to investigate the impact of dietary intervention with figs, avocado and olive oil on the arthritic mediators and immune status of RA patients. As olive oil, figs and avocado are rich sources of a variety of dietary bioactive compounds, especially the polyphenolic flavonoids that have been associated with antioxidant, anti-inflammatory, analgesic and anti-arthritic effects. Disease activity evaluated by disease activity score of 28 joints (DAS28). The arthritic patients divided into control Group (CG), and treated groups divided into avocado olive group (AOG) administered one serve of avocado pulp 2 Tbsp plus olive oil 1 tsp /day, fig/olive group (FOG) received one serve of fig (2 medium) plus olive oil 1 tsp per day, combined group (FAOG) administered of fig, avocado and olive oil. The results found that the majority of patients had a DAS of less than 3.2 to 2.6 with median pain. BMI was defined as overweight in CG, FOG, AFOG, and obese in AOG, and WHR was elevated. RF was decreased at higher significant values (P-value $\leq 0.001$) after dietary intervention. AFOG had the greatest impact of RA and CRP after dietary intervention, and had the greatest improvement in ameliorating immunoglobulins, both AOG and FOG were considerably im-

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proved (P-value 0.001). TG and TC were decreased significantly at (P-value≤0.001) in all treated groups. HDLc and LDLc were significantly refined particularly in combined group. The study concluded that the dietary intervention with at least one serve of fig and avocado in combination with olive oil may ameliorate the inflammatory mediators of arthritics and promote the immune status of RA patients.

Keywords: Osteoarthiritis, anti-inflammatory, rheumatoid factor, C-reactive protein, immunoglobulins.

## Introduction

Rheumatoid arthritis (RA) is an autoimmune disorder distinguished by systemic inflammation that destroys joints, resulting in disability and perhaps shortening life span (Smolen et al., 2015). It affects 0.5–1% of the worldwide population (Zyrianova, 2011). Furthermore, due to their extremely painful joints and inflammation, RA patients have greater limitations in increasing their physical activity, resulting in irreversible joint destruction and fatigue, as well as impaired physical functioning, work productivity, and activities of daily living, posing a significant human and economic burden (Yang et al., 2013). However, existing treatments, such as nonsteroidal anti-inflammatory medicines, glucocorticosteroids, and immune suppressants, are ineffective and usually harmful. Botanical medications have recently gained popularity as alternative therapies due to their efficacy. The activity of reactive oxygen species (ROS) has been linked to disruptive, proliferating synovitis in rheumatoid arthritis (RA) (McInnes and Schett, 2011). Some nutrients are thought to help with inflammatory and oxidant/antioxidant state in RA patients (Prescha et al., 2018). According to Seven et al., (2008), total antioxidant status in RA is adversely related to dis-

ease activity and duration; moreover, a low concentration of antioxidant components in the blood has been identified as a risk factor for RA (Sarban et al., 2005). In RA, the supply of foods and nutrients regulating antioxidant and anti-inflammatory defense was substantially linked with clinical state (Prescha et al., 2018). Evaluation of food quality and its association with anti-inflammatory status in RA patients may assist identify dietary behaviors and nutrient intakes that are important for improving antioxidant defense and, as a result, reducing RA symptoms (Jalili et al., 2014). Supplementation with antioxidant vitamins, polyphenols, and fatty acid profiles has been proven in several trials to enhance oxidant status and reduce disease activity. Plants are the richest source of bioactive chemicals, which have been shown to have many health advantages in the treatment of chronic illnesses. According to Rosillo et al., (2014), phenolic compounds found in virgin olive oil have anti-inflammatory capabilities. Support the development of therapeutic treatments for arthritic disorders using natural diet components. Because fruits like figs and avocado are high in polyphenolic flavonoids, which have been linked to antioxidant, anti-inflammatory, and analgesic effects (Basu et al., 2018), also figs contain the highest levels of anthocyanins and have the highest antioxidant capacity (alişkan and Aytekin-Polat, 2011), recent scientific studies have suggested that figs and avocado may have anti-inflammatory properties. Avocado is an oil-rich fruit, a high nutritional value, and health advantages due to the bioactive compounds it contains. Avocado pulp is high in unsaturated fatty acids (60 percent oil, mostly monounsaturated fatty acids), as well as vitamins B, C, and E, as well as potassium and dietary fibers (Alkhalaf et al., 2019). Phenolic substances (such as hydroxycinnamic acids, flavonoids, and proanthocyanins), acetogenins, phytosterols, carotenoids, and alkaloids

are all found in avocado (Bhuyan et al., 2019). The goal of this study was to see how a dietary intervention with figs, avocado, and olive oil affected RA patients' arthritic mediators and immunological state.

## Subjects and Methods

### Patient Recruitment

An intervention case-control study enrolled sixty-three adult male RA patients aged from 35 to 60. The participants were recruited from the outpatient rheumatology clinic and physical therapy of Shebin El-Kom Teaching Hospital, Menoufia Governorate, followed General Organization of Teaching Hospitals and Institution, Ministry of Health, Egypt. All cases were diagnosed under the supervision of rheumatologist and physical therapy specialist. The study started from November 2018 to May 2019.

The participants fulfilled in the study according to the meeting criteria: if they applied the 1987 American College of Rheumatology (ACR) classification criteria for RA (Briot et al., 2009), and also if patients were accepted to associate in the study. Inclusion criteria were disease duration more than 2 years, disease activity i.e. DAS-28 $\geq$ 2.6 that was clinically confirmed and under adequate control and medication at the screening visit. DAS-28 stands for Disease Activity Score, where swelling and tenderness in 28 different joints are evaluated in combination with information on erythrocyte sedimentation rate (ESR) as well as patient-reported global assessment of health (DAS-28, 2017).

Patients were excluded from the study if they had other chronic diseases as diabetes mellitus, renal and hepatic or taking medications either or dietary supplementation for over three months that may affect RA or following diet; also exclude smoking ones'.

## Consent Form and Ethical Approval

All participants giving an informed consent and the study was approved by the head of out-patient clinics of Shebin El-kom Teaching Hospital. At the screening visit, study details were presented, written informed consent was obtained from all subjects before enrollment.

## Methods of Data Collection and Measurements

## Patient's Characteristics

Disease-specific variables (age, gender, BMI, and disease duration) were reported. The data of drug use and vitamin D supplementation were collected.

## Clinical Evaluation

Disease activity evaluated by Disease Activity Score of 28 joints (DAS28) (high > 5.1; 3.2 < moderate ≤ 5.1; 2.6 < low ≤ 3.2; and remission ≤ 2.6). Patients agreeing to participate and fulfilling all inclusion criteria were thereafter invited to baseline measurements within a few weeks. These included clinical phenotype, body composition (bioelectric impedance spectroscopy) and health assessment, serum samples for blood lipids, inflammation markers (e.g., high-sensitive Creactive protein (hs-CRP).

## Study Design

The arthritic patients who involved all conclusion criteria was given a full overview of the methodology in simple terms before being signed with their informed written consent and assigned randomly to one of the experimental groups as follow:

- **Control Group (n=10):** involve patients who prescribed their conventional supervised antiartheritic medications

without any dietary management. Experimental groups divided into:

- **Avocado olive group (AOG)** (n=16): involve patients who received their described medicines and dietary intervention with one serve of avocado pulp 2 Tbsp (1 oz, 28 gm) per day and olive oil 1 tsp (5 gm) per day.
- **Fig olive group (FOG)** (n=17): involve patients were received their described medicines and dietary intervention with one serve of fig (2 medium "3 1/2 oz", or 85 gm) and olive oil 1 tsp (5 gm) per day (**Khan, 2017**).
- **Combined group (FAOG) (n=20)**: involve patients who received their described medicines and dietary intervention with combined formula of fig (85 gm), avocado (28 gm) and olive oil (5 gm).

The nutritional intervention was administered and followed for three consecutive months.

## Study measurements

## Anthropometric measurements

Anthropometric measurements include body weight, height, and body mass index was assessed and calculated according to the equation [BMI = body weight (kg)/height ($m^2$)] **(WHO, 2004).**

Arthritic biomarkers and Inflammatory profiles

Rheumatoid factor (RF) and C-reactive protein (CRP) was determined according the method described by **Woodhouse, (2002); and O'Dell, (2008)**.

Determination of Albumin: 5 ml of blood sample were taken from patients to determine albumin (g/dL) according to **Henry, (1964), u**ric acid was determined according to Carawy, (1955).

## Immunological mediators

IgM, IgA, IgG were determined according the method described by **Rose et al., (2002) and Sheehan, (1997).**

## Statistical analysis

Continuous variables were expressed as mean and standard deviation, and categorical variables as number (percentage). Comparison of categorical variables was done by chi-square. Continuous variables were compared by Student's*t*-test. Comparison of continuous variables experimental groups was done using one-way analysis of variance (ANOVA) test. Statistical analysis was performed using Microsoft office Excel and IBM SPSS Version 22.0. Statistical significance is expressed as $*P \leq 0.05$, $**P \leq 0.01$ **(SPSS, 2015)**.

## Results

The frequency and key characteristics of patients with rheumatoid arthritis are shown in Table 1. As 63.5 % of patients are female, while 36.5 % are male. Disease recurred in 46% of instances after a period of more than ten years. In terms of BMI, around half of the patients (50.8%) have a BMI that falls into the obese category, while 42.8 percent have a BMI that falls between 25 and 29.9 kg/m2. In terms of DAS-28, a rheumatoid arthritis disease activity score, the majority of patients had a score of less than 3.2 to 2.6 with median pain, with 60, 81.3, and 55 % in CG, AOG, and AFOG, respectively, while FOG has 82.4 % DAS-28 stage at less than 2.6.

**Table 1.** Characters of rheumatoid arthritis patients

| variables | | CG | | AOG | | FOG | | AFOG | | P-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Freq. | % | Freq. | % | Freq. | % | Freq. | % | |
| **Gender** | Male | 6 | 60 | 9 | 56.3 | 5 | 29.5 | 7 | 35 | 0.257 |
| | Female | 4 | 40 | 7 | 43.8 | 12 | 70.6 | 13 | 65 | |
| **Incidence of RA** | Less than 10 y | 5 | 50 | 9 | 56.3 | 6 | 35.3 | 14 | 70 | 0.000 |
| | More than 10 Y | 5 | 50 | 7 | 43.8 | 11 | 64.7 | 6 | 30 | |
| **BMI ($kg/m^2$)** | 18.5 – 24.9 | -- | -- | -- | -- | 2 | 11.8 | 2 | 10 | 0.000 |
| | 25-29.9 | 5 | 50 | 6 | 37.5 | 8 | 47.1 | 8 | 40 | |
| | 30 and more | 5 | 50 | 10 | 62.5 | 7 | 41.2 | 10 | 50 | |
| **DAS-28** | Less than 2.6 | 1 | 10 | -- | -- | 14 | 82.4 | 9 | 45 | 0.000 |
| | Less than 3.2 – 2.6 | 6 | 60 | 13 | 81.3 | 3 | 17.6 | 11 | 55 | |
| | Greater than 5.1 | 3 | 30 | 3 | 18.8 | -- | -- | -- | -- | |

CG: Control group; AOG: Avocado olive oil group; FOG: Fig olive oil group; AFOG: Avocado fig olive oil group; BMI: Body mass index; DAS-28: Disease active score-28. The values are means ± SD.; SD: standard deviation. LSD: letter was calculated among groups. The significant differences are considered at the levels 0.05 (*), 0.01 (**), and 0.001 (***); NS=Non significant. P-value was statistic based on results after dietary intervention.

Table 2 illustrates the anthropometric measures of RA patients who participated in this study. Patients are over forty years old, they had an average age of 48.21±6.25 and 50.49±6.35 in CG and AFOG, respectively. BMI was defined as overweight in CG

(29.18±2.22), FOG (29.27±2.85), AFOG (29.87±2.67), and obese in AOG (30.49±1.99), with body weight ranging between 74.24±6.13 and 79.23±6.30 in FOG and AOG, respectively. Means (99.14±10.56 vs 111.88±9.73) and (100.10±8.99 vs 111.88±9.73) for CG and FOG, respectively revealed that waist and hip measurements were greater than normal norms. As a result, WHR, one of the markers used to assess if excess weight is setting one's health at risk, was elevated between 0.96±0.06 and 1.01±0.07 in AFOG and AOG, respectively.

**Table 2.** Anthropometric measurements of RA patients

| | CG | AOG | FOG | AFOG | P-value |
|---|---|---|---|---|---|
| Age | 48.21±6.25 | 49.01±6.67 | 48.36±6.61 | 50.49±6.35 | 0.705 |
| Weight | 78.67±6.63 | 79.23±6.30 | 74.24±6.13 | 75.82±8.59 | 0.177 |
| Height | 164.24±6.14 | 161.23±6.78 | 159.41±3.74 | 159.30±7.26 | 0.174 |
| BMI | 29.18±2.22 | 30.49±1.99 | 29.27±2.85 | 29.87±2.67 | 0.465 |
| Waist circum. | 111.88±9.73 | 108.97±12.64 | 99.14±10.56 | 101.16±17.60 | 0.052 |
| Hip circum. | 114.01±8.35 | 107.75±12.80 | 100.10±8.99 | 105.22±15.15 | 0.042 |
| WHR | 0.98±0.05 | 1.01±0.07 | 0.99±0.06 | 0.96±0.06 | 0.191 |

CG: Control group; AOG: Avocado olive oil group; FOG: Fig olive oil group; AFOG: Avocado fig olive oil group; BMI: Body mass index; WHR: Waist hip ratio. The values are means ± SD.; SD: standard deviation. LSD: letter was calculated among groups. The significant differences are considered at the levels 0.05 (*), 0.01 (**), & 0.001 (***); NS=Non significant. P-value was statistic based on results after dietary intervention.

Table 3 revealed the arthritic factors and markers of systemic inflammation in rheumatoid arthritis patients. RF was elevated

among rheumatoid patients, while it was decreased at higher significant values (P-value ≤ 0.001) after dietary intervention particularly AFOG (11.67±2.26) compared to CG (51.90±5.25), while no significant difference between AOG and FOG. CRP, a key marker in the inflammatory cytokines related to RA, as well as promoting atherogenic impacts, was reduced with higher significant values (P-value ≤ 0.001) among treated groups, AFOG had the greatest impact after dietary intervention reach to 4.02±1.04 versus 15.11±1.80 mg/dL before set. While AOG and FOG decreased by means 10.68±3.23 and 8.39±1.40, respectively. For metabolic profiles that was affected by RA, serum albumin was ameliorated significantly after nutritional supplements with higher values in AFOG 3.74±0.31 g/dL, while no significant difference between AOG and FOG by 3.37±0.12 vs. 3.54±0.26 g/dL, respectively. Uric acid was decreased significantly with higher significant impact (P-value ≤ 0.001) after dietary intervention in FOG (3.75±0.96 mg/dL) than AOG and AFOG at means 4.71±1.22 and 5.36±0.71 mg/dL compared to CG 7.43±0.59 mg/dL.

Table 4 illustrates that after following dietary intervention, immunoglobulin indicators IGM, IgG, and IgA were significantly improved (P-value≤0.001). AFOG showed the greatest improvement in ameliorating immunoglobulins at a higher significant value than the other treatment groups, by means of 196.01±32.88, 391.63±50.02, and 320.92±61.17 mg/L, respectively. After nutritional intervention, both AOG and FOG were considerably improved (P-value 0.001), although there was no difference in IgM (408.56±33.55 and 372.90±68.51 mg/dL). IgG and IgA were significantly enhanced by means of 654.89±41.39 vs 635.81±73.62 for AOG and 514.65±59.50 vs 473.08±68.55 for FOG.

**Table (3).** Determination of inflammatory factors and metabolic profiles of RA before and after dietary intervention

| | | CG | AOG | FOG | AFOG | P-value |
|---|---|---|---|---|---|---|
| RF | Before | 53.21±5.66a | 54.71±7.17a | 52.70±7.07a | 52.60±5.32a | 0.823 |
| **(≥20 IU/ml)** | After | 51.90±5.25a | 12.47±2.47bc | 13.70±1.94b | 11.67±2.26c | 0.000 |
| Sig. | | 0.703 | 0.000 | 0.000 | 0.000 | |
| CRP | Before | 15.65±1.88ab | 15.79±1.84ab | 16.81±1.30b | 15.11±1.80a | 0.055 |
| **(3.0 mg/dL)** | After | 14.40±1.37a | 10.68±3.23b | 8.39±1.40c | 4.02±1.04d | 0.000 |
| Sig. | | 0.090 | 0.001 | 0.000 | 0.000 | |
| Albumin | Before | 3.08±0.21a | 3.07±0.22a | 3.05±0.15a | 3.16±0.12a | 0.287 |
| **3.5 to 5.5 (g/dL)** | After | 3.13±0.11c | 3.37±0.12b | 3.54±0.26b | 3.74±0.31a | 0.000 |
| Sig. | | 0.565 | 0.000 | 0.000 | 0.000 | |
| Uric acid. | Before | 7.18±0.83a | 7.11±0.80a | 6.47±1.01ab | 6.42±1.05b | 0.060 |
| **2.4-7.0 mg/dL** | After | 7.43±0.59a | 4.71±1.22a | 3.75±0.96b | 5.36±0.71a | 0.000 |
| Sig. | | 0.000 | 0.000 | 0.000 | 0.002 | |

CG: Control group; AOG: Avocado olive oil group; FOG: Fig olive oil group; AFOG: Avocado fig olive oil group; RF: Rheumatoid factor; CRP:.C-reactive protein; IU/ml: International unit per milliliter; g/dL : grams per deciliter; mg/dL: milligramme per décilitre. The values are means ± SD.; SD: standard deviation. LSD: letter was calculated among groups. The significant differences are considered at the levels 0.05 (*), 0.01 (**), & 0.001 (***); NS=Non significant. P-value was statistic based on results after dietary intervention.

**Table (4).** Determination of immunoglobulin profiles of RA before and after dietary intervention

| | | CG | AOG | FOG | AFOG | P-value |
|---|---|---|---|---|---|---|
| IgM (40–230 mg/dl ) | Before | 702.70±34.05a | 873.20±16.14b | 831.33±41.31b | 765.42±12.22c | 0.000 |
| | After | 828.50±81.50a | 408.56±33.55b | 372.90±68.51b | 196.01±32.88c | 0.000 |
| Sig. | | 0.000 | 0.000 | 0.000 | 0.000 | |
| IgG | Before | 793.40±23.94d | 873.53±42.02b | 893.71±15.53ab | 839.42±45.39bc | 0.000 |
| | After | 886.30±15.31a | 654.89±41.39b | 514.65±59.50c | 391.63±50.02d | 0.000 |
| Sig. | | 0.000 | 0.000 | 0.000 | 0.000 | |
| IgA (80 – 350 mg/dL) | Before | 790.40±31.70a | 793.57±32.57a | 719.85±42.42c | 754.01±41.15b | 0.000 |
| | After | 771.51±64.96a | 635.81±73.62b | 473.08±68.55c | 320.92±61.17d | 0.000 |
| Sig. | | 0.392 | 0.003 | 0.000 | 0.000 | |

CG: Control group; AOG: Avocado olive oil group; FOG: Fig olive oil group; AFOG: Avocado fig olive oil group; IgM: Immuno-globulin M; IgG: Immunoglobulin; IGA: Immunoglobulin A. mg/dL :milligramme per décilitre. The values are means ± SD.; SD: standard deviation. LSD: letter was calculated among groups. The significant differences are considered at the levels 0.05 (*), 0.01 (**), & 0.001 (***); NS=Non significant. P-value was statistic based on results after dietary intervention.

Table 5 shows the lipid profiles of RA patients, TG and TC were decreased significantly at (P-value≤0.001) after dietary intervention in all treated groups especially in AFOG by means 110.25±8.39 and 148.43±6.93, respectively. HDLc and LDLc were significantly refined particularly in combined group that have all dietary enhancements. AFOG had the best impact on reducing LDL and improving HDL compared to pre-reinforcement by means (40.25±2.98 vs 22.87±2.52 mg/dL) and (103.52±5.03 vs. 137.32±5.71 mg/dL), respectively. There is no significant difference between AOG and FOG in terms of HDL, however they were

substantially different in terms of at (P-value≤0.001) in TG, TC and LDL.

**Table (5).** Determination of lipid profiles of RA patients before and after dietary intervention

| | | CG | AOG | FOG | AFOG | P-value |
|---|---|---|---|---|---|---|
| TG | Before | 175.09±10.77a | 168.62±7.44a | 172.34±12.41a | 175.41±7.49a | 0.224 |
| Less than 150 mg/dL | After | 174.65±8.57a | 118.51±6.15b | 130.47±4.29c | 110.25±8.39d | 0.000 |
| Sig. | | 0.932 | 0.000 | 0.000 | 0.000 | |
| TC | Before | 193.51±10.04[a] | 179.09±3.24[b] | 179.50±4.17bc | 176.30±6.83c | 0.473 |
| Less than 200 mg/dL | After | 186.01±19.92a | 152.39±6.23b | 160.03±6.12bc | 148.43±6.93c | 0.000 |
| Sig. | | 0.365 | 0.000 | 0.000 | 0.000 | |
| HDLc | Before | 24.49±3.60a | 24.58±3.94aa | 22.98±2.78a | 22.87±2.52a | 0.642 |
| Higher than 40 mg/dL | After | 23.02±3.27c | 35.89±3.06b | 35.46±3.18b | 40.25±2.98a | 0.000 |
| Sig. | | 0.379 | 0.000 | 0.000 | 0.000 | |
| LDLc | Before | 139.38±4.30a | 136.84±4.80a | 134.23±4.95a | 137.32±5.71a | 0.492 |
| Less than 100 mg/dL | After | 131.55±2.57a | 119.97±3.66b | 121.21±3.07c | 103.52±5.03d | 0.000 |
| Sig. | | 0.003 | 0.000 | 0.000 | 0.000 | |

CG: Control group; AOG: Avocado olive oil group; FOG: Fig olive oil group; AFOG: Avocado fig olive oil group; TG: Triglyceride; TC: Total cholesterol; HDLc: High Density lipoproteins; LDLc: Low density lipoprotein. mg/dL :milligramme per décilitre. The values are means ± SD.; SD: standard deviation. LSD: letter was calculated among groups. The significant differences are considered at the levels 0.05 (*), 0.01 (**), & 0.001 (***); NS=Non sig-

nificant. P-value was statistic based on results after dietary intervention.

## Discussion

Arthritis (OA) is a systemic inflammatory disease characterized by progressive and deteriorating joint disease, inflammation, chronic pain, functional impairment, and diminished quality of life (Wallace et al., 2017; Wirth et al., 2017). According to the current study, the majority of patients had a DAS-28 score of 3.2 to 2.6 with median discomfort. However, there is no definitive treatment or way to prevent RA at the time. To decrease the extent of irreversible joint damage, existing recommendations advocate rapid diagnosis and well-monitored therapy with Disease Modifying Anti-Rheumatic Drugs (DMARDs) and biologic medicines (Singh et al., 2012). Despite advancements in RA diagnosis, present medication therapy have limited efficacy and should be taken with carefully due to commonly reported severe and toxic consequences (Soeken et al., 2003). Because rheumatoid arthritis (RA) is marked by joint dysfunction caused by inflammation and severe pain, anti-inflammatory medications may reduce clinical symptoms in RA.

In the present study, BMI was defined as overweight in CG, FOG, AFOG, and obese in AOG, around half of the patients have a BMI that falls into the obese category, while 42.8 % have a BMI that falls between 25 and 29.9 kg/m2. WHR was raised, which is one of the indicators used to determine if excess weight is putting one's health at risk. These findings are in line with Dar et al., (2018), who found that obesity is a contentious health concern for rheumatoid arthritis (RA). Obesity and RA may be connected because adipose tissue contains biochemical processes of inflammation and immune response that may be linked to persistent systemic inflammation (Crowson et al., 2013). Obesity-related pro-

inflammatory cytokines are thought to be the relationship between obesity and inflammation (Hotamisligil et al., 2006). Furthermore, when a waist-to-hip ratio (WHR) of 1.0 or above (WHO, 2008), a sensitive marker of visceral obesity, was associated with chronic inflammation in obese participants, and body adiposity index (BAI) was independently connected with CRP ( Kawamoto et al., 2013). As a result, non-pharmacological treatments to OA care include weight reduction diets and exercise regimens, whilst anti-inflammatory foods and supplements have been proven to prevent RA recurrence (Vasiljevic et al., 2016; Hajjaj-Hassouni et al., 2017). Controlling pain and swelling, delaying disease progression, minimizing disability, and improving clinical status are all aims in the treatment of RA patients. Therefore, the present research looked at the benefits of avocado and fig fruits mixed with olive oil on RA inflammatory and immune mediators.

Rheumatoid factors are immune system proteins that can target healthy tissue in the body. Rheumatoid factor levels in the blood are frequently linked to autoimmune illnesses like rheumatoid arthritis. According to the current findings, RF was elevated in rheumatoid patients, but it was reduced at higher significant values (P-value $\leq$ 0.001) after dietary intervention, especially in AFOG. CRP, a sensitive marker of systemic inflammation synthesized by the liver, is also an immune regulator that plays an important role in inflammatory pathways associated with RA and promotes atherogenic effects (Backes et al., 2004). In this work, CRP was reduced with higher significant values (P-value $\leq$ 0.001) among treated groups, AFOG had the greatest impact after dietary intervention. Moreover, immunoglobulin indicators IGM, IgG, and IgA were significantly improved (P-value$\leq$0.001). AFOG showed the greatest improvement in ameliorating immunoglobulins at a higher signifi-

cant value than the other treatment groups compared to control group. The phenolic compounds and other phytochemicals included with dietary intervention with olive oil, figs, and avocado may be responsible for the prospective benefit. Olive oil and fresh or dried figs are high in polyphenolic components such oleuropein and hydroxytyrosol, chlorogenic acid, protocatechuic acid, and rutin, which are responsible for their biological effects and symptom relief in arthritis patients (Russo et al., 2014; Saibandith et al., 2017). Olive and fig have also been employed in inflammatory illnesses such as inflammatory swellings and hard swellings, according to ethnopharmacological literature and conventional beliefs (Gilania et al., 2008).

Olive and fig are two herbal therapies that have been extensively studied and substantiated to have anti-inflammatory, immunomodulatory, analgesic, and anti-oxidant properties; their biologic properties are primarily due to oleic acid and phenolic components (Eidi et al., 2012; Souria et al., 2004). In addition, lupeol, a dietary triterpene present in olive and fig fruit, has been demonstrated to have anti-inflammatory, anti-arthritic, and anti-mutagenic properties (Saleem, 2009; Chaturvedin et al., 2008). Similarly, in a research by Brzeski et al. (1991), they discovered that using olive oil for 6 months reduced pain and articular index in patients. Park et al. (2009) found that the hexane soluble fraction of the common fig is a strong inhibitor of osteoclastogenesis in an ex-vivo investigation, suggesting that it might be used to treat bone-destructive diseases such osteoporosis, rheumatoid arthritis, and periodontal bone resorption. "The ACR supports the integration of fig and olive proven to be safe and effective by scientifically rigorous clinical trials published in the biomedical peer review literature," the American College of Rheumatology (ACR) stated in a position statement

on complementary and alternative medicine (CAM) for rheumatic diseases released in 2012 (Phang et al., 2018). Oleuropein, the predominant phenol in olive oil (1.4 mg/100g edible portion), initiates hydrolysis to give hydroxytyrosol (Saibandith et al., 2017). It was linked to a variety of health advantages, including antioxidant, anti-inflammatory, and anti-diabetic properties, as well as arthritis relief in animal models (Rosillo et al., 2016; Dyer et al., 2017). Berbert et al. (2005) found that combining olive oil with other supplements has a stronger remission impact on RA symptoms in a clinical experiment. Similarly, Brzeski et al. (1991) discovered that after 6 months, olive oil may dramatically lower pain and articular index in patients. Rutin (29 mg/100g), catechin (4 mg/100g), and chlorogenic acid (1.7 mg/100g) are the most prevalent phenolic acids in figs. A combination of olive oil and figs was demonstrated to postpone RA recurrence in patients (Russo et al., 2014; Bahadori et al., 2016). Park et al. (2009) found that the hexane soluble fraction of the common fig might help treat bone-destructive diseases such osteoporosis, rheumatoid arthritis, and periodontal bone resorption in an ex-vivo research. Also, avocados were high in polyphenolic chemicals, which have antioxidant and anti-inflammatory properties. The extract's total phenolic, total flavonoids, fatty acid profile, phytosterols, and hydrocarbons were all determined. Because of its antioxidant and anti-inflammatory properties, acetogenin-rich avocado pulp extract can be utilized as an alternative medication for rheumatoid arthritis prevention and treatment. Avocados are also high in lutein, a carotenoid. Avocados, unlike other fruits, are abundant in vitamin E, a micronutrient with anti-inflammatory properties, and diets rich in these components have been associated to a lower risk of joint injury in arthritic patients (Bhuyan et al., 2019).

## Conclusion

The present study concluded that the administration of those fruits fig and avocado in combination with olive oil may ameliorate the inflammatory mediators of arthiritics and promote the immune status of patients.

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# التأثير المضاد لالتهاب المفاصل للتين والأفوكادو مع زيت الزيتون على حدة نشاط المرض والحالة المناعية لمرضى هشاشة العظام

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يهدف البحث إلى دراسة تأثير التدخل الغذائي بالتين والأفوكادو وزيت الزيتون على مؤشرات التهاب المفاصل والحالة المناعية لمرضى التهاب المفاصل الروماتويدي. يعتبر زيت الزيتون والتين والأفوكادو مصادر غنية لمجموعة متنوعة من المركبات النشطة بيولوجيا، وخاصة مركبات الفلافونويد البوليفينولية التي ارتبطت بمضادات الأكسدة ، ومضادات الالتهابات ، وتأثيرها المسكن، والمضاد لالتهاب المفاصل. تم تقييم نشاط المرض من خلال درجة نشاط المرض لـ ٢٨ مفصل (DAS28). تم تقسيم مرضى التهاب المفاصل إلى مجموعة الكنترول (CG) ، والمجموعات المعالجة مقسمة إلى مجموعة زيت الأفوكادو (AOG) تتناول حصة واحدة من لب الأفوكادو ٢ ملعقة كبيرة بالإضافة إلى ١ ملعقة صغيرة من زيت الزيتون في اليوم ، وحصلت مجموعة زيت الزيتون (FOG) على حصة واحدة من التين (٢ وحدة متوسطة) بالإضافة إلى زيت زيتون ١ ملعقة صغيرة يوميًا ، المجموعة المشتركة (FAOG) تتناول كل من التين والأفوكادو وزيت الزيتون. وجدت النتائج أن غالبية المرضى لديهم DAS أقل من ٣,٢ إلى ٢,٦ بألم متوسط. وجد مؤشر كتلة الجسم عند مستوى زيادة الوزن في CG و FOG و AFOG والسمنة في AOG. انخفض عامل الروماتويد عند قيم معنوية أعلى (قيمة $P\leq 0.001$) بعد التدخل الغذائي. كان لمجموعة AFOG التأثير المحسن الأفضل في نسب RA و CRP بعد التدخل الغذائي ، وكان له أكبر معدل تحسين في الجلوبولينات المناعية ، تم تحسين كل من AOG و FOG بشكل كبير (قيمة P $\leq 0.001$). انخفض الجلسريدات الثلاثية و الكولستيرول الكلي معنويا عند (P-value$\leq 0.001$) في جميع المجموعات المعالجة. تم تعديل و تحسن الليبوبروتينات عالية الكثافة و الليبوبروتينات منخفضة الكثافة بشكل كبير خاصة في المجموعة المشتركة. وخلصت الدراسة إلى أن التدخل الغذائي بحصة واحدة على الأقل من التين والأفوكادو مع زيت الزيتون قد يخفف من التهابات مؤشرات الروماتويد ويعزز الحالة المناعية لمرضى التهاب المفاصل الروماتويدي.

**الكلمات المفتاحية**: التهاب المفاصل - مضاد للالتهابات – عامل الروماتويد - الجلوبولينات المن