Medicinal Uses of Maslinic Acid: A Review

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Abstract

Maslinic Acid a characteristic compound of the triterpenoid bunch got from olive which forestalls the age of favorable to fiery cytokines and oxidative pressure, found in an assortment of common sources, going from home grown cures utilized in traditional medicine to consumable vegetables and organic products present in the Mediterranean eating routine. A few investigations have demonstrated that maslinic acid a wide scope of pharmacological effects such as Antimalarial Effect, Anti-Proliferative Activity, Antitumor Activity, Antifungal Activity, Antibacterial Activity, Anti-diabetic Effect, Antioxidant effect, Anti-inflammatory Activity, Cardio protective effect, Neuroprotection effect, Antiviral Activity, Antimicrobial Activity.

Keywords: Maslinic acid, Triterpene, edible source, Pharmacological Effects.

INTRODUCTION

Maslinic Acid (MA, 2α, 3β-dihydroxyolean-12-en-28-oic acid) is a characteristic compound of the triterpenoid gathering, gotten from olive, and is known by the plant name Olea europaea.¹

The pharmacological activities of maslinic acid have been surveyed in various exploratory models, from tumor cell lines to creature models of a few illnesses, upheld by the absence of antagonistic impacts in vivo after the oral organization of the triterpene.²

In equal, because of an expanding interest to recognize new normal atoms with valuable impacts on wellbeing, maslinic acid has been disconnected not just from different plants utilized in customary natural medication, additionally from palatable vegetables and organic products. it as a triterpenoid carboxylic corrosive with sub-atomic equation C30H48O4, essentially found in the leaves of the previously mentioned species, where it represented 25%–30% of the measure of triterpenoids in this tissue.³

Figure 1: Chemical structure of Maslinic Acid

Maslinic acid content in edible sources such as Fresh vegetables (Eggplant, Spinach), Aromatic herbs (Leaf mustard, Brown mustard), Fresh fruits (Pomegranate), Cooked legumes (Large lentils, Chickpeas), Gordal (plain green) etc.
**PHARMACOLOGICAL ACTIVITIES OF MASLINIC ACID**

The pharmacological activities of maslinic acid as shown in figure 2 and briefly discussed following are:

**Antimalarial Effect**
This studied show that low poisonous characteristic pentacyclic triterpene for which a wide assortment of organic and helpful exercises have been accounted for. Past work uncovered that Plasmodium falciparum erythrocytic societies were repressed by MA, which had the option to frustrate the development from ring to schizont stage and, as a result, forestall the arrival of merozoites and the ensuing attack. We show here that MA adequately represses the proteolytic preparing of the merozoite surface protein complex, presumably by restraint of PfSUB1.4

**Anti-Proliferative Activity**
The studied that exhibited interestingly the powerful enemy of proliferative movement of maslinic in the human colorectal adenocarcinoma cell line HT-29. The triterpene didn’t show vague cytotoxicity up to 250 μM, yet applied a portion subordinate enemy of proliferative action with IC50 of 101.2 μM at 72 h of openness.5

**Antitumor Activity**
The antitumor action of MA has gotten striking as of late, as proven by the higher number of studies that address this issue, contrasted with those about other organic impacts. By far most of distributed references relate to in vitro tests that show the counter proliferative as well as favorable to apoptotic impact of maslinic corrosive, along with conceivable components of activity that include diverse flagging pathways. This was performed with athymic nu/nu mice in which xenograft pancreatic cells were embedded. The subcutaneous organization of 10 and 50 mg/kg of the triterpene altogether diminished in a portion subordinate way both the volume and the heaviness of the tumors, which thusly showed an expanded number of apoptotic cells and a decreased articulation of two NF-κB-controlled enemy of apoptotic qualities, Survivin and Bcl-xl.6

**Antifungal Activity**
Antifungal action of MA assessed through the agar-well dispersion technique with changes.

Figure 2: Pharmacological activities of Maslinic acid
was filled clean standard Petri plates (20 mL) and afterward permitted to harden. The plates were immunized with 100 L of the microbial culture by spread plate method. By utilizing a sterile drill, four wells were punched.7

**Antibacterial Activity**

Antibacterial activities of MA arrangements on the principles (ciprofloxacin and amoxicillin), and the dissolvable (DMSO) were stacked into particular wells, and afterward the Petri plates were hatched at 37 °C for 24 h. Brooding was done at 34 °C for 48 h for the antifungal action tests.7

**Anti-diabetic Effect**

The character stick of MA in glucose digestion has additionally been widely considered. The principal proof of the inhibitory impact of the triterpene on glycogen phosphorylases (GP), which catalyze the initial step of glycogen breakdown. In a first in vitro test utilizing GPs (initiated type of the compound) disconnected from rodent liver, maslinic acid restrained the catalyst with an IC50 of 99 μM, being 6-crease more intense than caffeine, a set up GP inhibitor. Based on the hypoglycemic movement of the triterpene was assessed in vivo, utilizing a mouse model of diabetes incited by adrenalin, which is known to by implication invigorate glycogenolysis and along these lines increment glucose blood fixation.6

**Antioxidant effect**

The antioxidant impact of MA was first assessed in a model of oxidative status actuated by CCl4, which incites lipid peroxidation. Pre-treatment of the rodents once day by day for 3 days with the triterpene at different dosages diminished by around 18% plasma levels of endogenous lipid peroxides, at the two portions, and by 6.5% and 19%, individually, the triterpene disengaged from the blossoms of Punica granatum forestalled the CuSO4-initiated oxidation of hare plasma LDL, checked by the development of dienes.9

**Anti-inflammatory Activity**

The anti-inflammatory effect of maslinic acid has been additionally demonstrated in essential cortical astrocytes, which could be meant a neuroprotective impact if further affirmed in vivo. Cells were refined with the different triterpene for 24 h prior to being presented to LPS. The concentration here was the TNF-α flagging pathway, which is to some degree intervened by NF-κB. As recently depicted, this record factor is found in the cytosol, held by IkBα. Under incitement, IkBα is phosphorylated and afterward the p65 subunit of the record factor is delivered, which permits its movement to the core.10

**Cardio protective Effect**

The cardioprotective impact of maslinic corrosive has likewise been tried in isoproterenol-instigated myocardial localized necrosis in Wistar rats. Animals that had been pre-treated with MA at (15 mg/kg) for 7 days showed an improved serum lipid profile with fundamentally diminished degrees of complete cholesterol, fatty substances, LDL cholesterol, VLDL-cholesterol and expanded HDL cholesterol. The movement of the heart marker catalysts creatine kinase (CK), ALT, AST and γ-glutamyl transferase (GGT) essentially diminished.11

**Neuroprotection Effect**

This studied that maslinic acid forestalled mind harm after a transient ischemic scene in creatures. Since hyperglycemia is a danger factor for stroke streptozotocin-initiated diabetic rodents were given the triterpene orally at few dosages for 14 days. At that point, a transient center cerebral vein impediment was performed and the results of the localized necrosis were assessed.12

**Antiviral Activity**

The methanol remove from the entire plant of Geum japonicum was found to restrain the human immunodeficiency infection (HIV-1) protease. Through show some effective triterpene acid alongside five known triterpene acids, epimomic acid, maslinic acid, and euscaphic acid were detached. The design of the new compound was dictated by ghastly methods showed strong Inhibitory action against HIV-1 protease. The methods such as HMBC, 1H– 1H COSY, NOE etc.13

**Antimicrobial Activity**

Six triterpenoids having a lupane or oleane skeleton were confined from leaves and youthful parts of Licania heteromorpha var. heteromorpha (from Venezuela). They were screened for action against a battery of microorganisms. Aliphatic corrosive, 3β-O-trans-p-coumaroyl alphitolic corrosive, 3β-O-trans-p-coumaroyl maslinic corrosive and 3β-O-cis-p-coumaroyl maslinic corrosive showed action against Gram-positive microbes and yeasts. None of the 6 mixtures showed action against Gram-negative microscopic organisms.14

| Table 1: Inflammatory modulating effect of maslinic acid. |
|----------------------------------------------------------|
| **Modulatory effect of maslinic acid** | **Inflammatory model** |
| Maslinic acid-enriched diet inhibited the formation of polyps in the small intestines of ApcMin/+ mice by regulating genes associated with inflammation pathways | Spontaneous intestinal polyposis animal model.15 |
| Maslinic acid suppressed production of nitric oxide (NO) and inducible nitric oxide synthase (iNOS) gene expression, secretion of inflammatory cytokines interleukin-6, and tumour necrosis alpha (TNF-α) | Lipopolysaccharide- (LPS-) induced murine macrophages.16 |
| Maslinic acid inhibits the expression of iNOS and COX-2 as well as the release of proinflammatory mediators including NO and TNF-α | LPS-induced cortical astrocyte cultures.17 |
| Maslinic acid reduced NO levels and iNOS mRNA and protein expression | Oxygen-glucose deprivation-induced cortical neuron injury.18 |
| Maslinic acid given in simple topical treatments showed reduction of discomfort and considerable increase of flexibility of the joint | COX-2-related pathologies such as arthritis, arthrosis, or fibromyalgia.19 |
| Maslinic acid suppresses osteoclastogenesis by regulating receptor activator of NF-κB ligand- (RANKL-) mediated NF-κB and mitogen-activated protein kinase (MAPK) signaling pathways | Osteoclastogenesis and bone loss.20 |
| Maslinic acid reduced TPA-induced ear edema at the concentration of 0.13mg per ear | 12-O-Tetradecanoylphorbol-13-acetate- (TPA-) induced ear edema.21 |
CONCLUSION
Maslinic acid is a bunch of Triterpene obtained from olive being normal elements of plant-based dietary examples, like the Mediterranean eating routine. Various examinations surveying its pharmacological impacts have brought interest up in health-enhancing properties like Antimalarial Effect, Anti-Proliferative Activity, Antitumor Activity, Antifungal Activity, Antibacterial Activity, Anti-diabetic Effect, Antioxidant effect, Anti-inflammatory Activity, Cardio protective effect, Neuroprotection effect, Antiviral Activity, Antimicrobial Activity. Further research study on MA revealed that new mechanism of action would be broad spectrum effects on biological activities of the triterpene.

Disclosure Statement
There are no conflicts of interest.

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REFERENCES
1. Lozano MG, Sanchez GM, Juan ME, Planas JM, “Maslinic acid, a natural phytoalexin-type triterpene from olives—a promising nutraceutical” Molecules, 2014; 19:11538–11559.
2. Sanchez GM, Lozano MG, Juan ME, Garcia GA, Planas JM, “Assessment of the safety of maslinic acid, a bioactive compound from Olea europaea L” MNFR, 2013; 57:339–346.
3. Tschesche R, Heesch A, Fugmann R, “Über triterpenoide, III. Mittel.: Zur kenntnis der crataegolsäure” CB, 1953; 86:626–629.
4. Moneriz C, Mestres J, Bautista JM, Diez A, Puyet A, “Multi-targeted activity of maslinic acid as an antimalarial natural compound” FEBSJ, 2011; 276(1):2951–61.
5. Juan ME, Planas JM, Ruiz GV, Daniel H, Wenzel U, “Anti-proliferative and apoptosis-inducing effects of maslinic acid and oleanolic acids, two pentacyclic triterpenes from olives, on HT-29 colon cancer cells” BrJN, 2008; 100:36–43.
6. Li CY, Yang Z, Zhai C, Qiu W, Li D, Yi Z, Wang L, Tang J, Qian M, Luo J, et al, “Maslinic acid potentiates the anti-tumor activity of tumor necrosis factor α by inhibiting NF-κB signaling pathway” MC, 2010; 73(1):73:13.
7. Jamkhande PG, Pathan SK, Wadher SJ, “In silico PASS analysis and determination of antimycobacterial, antifungal, and antioxidant efficacies of maslinic acid in an extract rich in pentacyclic triterpenoids” JIM, 2016;5(4):417–425.
8. Wen XS, Sun H, Liu J, Wu G, Zhang L, Wu X, Ni P, “Pentacyclic triterpenes. Part 1: The first examples of naturally occurring pentacyclic triterpenes as a new class of inhibitors of glycerol phosphorylases” BMC, 2005; 15:4944–4948.
9. Wang R, Wang W, Wang L, Liu B, Ding Y, Du L, “ Constituents of the flowers of Punica granatum” Fitoterapia, 2006; 77:534–537.
10. Napetschnig J, Wu H, “Molecular basis of NF-κB signaling” ARB, 2013; 4:2443–4468.
11. Hussain SA, Rasoool SN, Abdul KM, Kruhnsa GS, Akhtar PM, Devi KL, “Maslinic acid protects against isooxoternal-induced cardiotoxicity in albino Wistar rats” JMFood, 2012; 15:741–746.
12. Kagansey N, Levy SKnoler H, “The role of hyperglycemia in acute stroke” AN, 2001;58:1209–1212.
13. Xu HX, Zeng FQ, Wan M, Sim KY, “Anti-HIV triterpene acids from Geum japonicum” JNP, 1996; 59(7):643–645.
14. Braca A,Morelli LM,ender J, Battinelli L, Braghiroli L, Mazzanti G, “Antimicrobial triterpenoids from Licania heteromorpha” PM, 2000; 66(8):768–769.
15. Sanchez TS, Reyes ZFJ, Diaz MS, et al, “Maslinic acid-enriched diet decreases intestinal tumor genesis in ApcMin/+ mice through transcriptomic and metabolomics reprogramming” PLoS ONE, 2013; 8(3):59592.
16. Marquez MA, Puerta Vazquez A, Fernandez Arche, Ruiz GA, “Suppressive effect of maslinic acid from pomace olive oil on oxidative stress and cytokine production in stimulated murine macrophages” FRRResearch, 2006; 40(3):295–302.
17. Huang TL, Guan Y, Qian et al, “Anti-inflammatory effects of maslinic acid, a natural triterpene, in cultured cortical astrocytes via suppression of nuclear factor-kappa B” EJP, 2011; 672(1–3):169–174.
18. Qian Y, Guan TT, Xang et al, “Maslinic acid, a natural triterpenoid compound from Olea europaea, protects cortical neurons against oxygen-glucose deprivation-induced injury” EJP, 2011; 670(1):148–153.
19. Osuna P, “Use of maslinic acid for the treatment of diseases and the symptoms thereof by means of cox-2 inhibition” US Patent US 20110105611A1, 2011.
20. Ci C, Yang Z, Li Z, et al, “Maslinic acid suppresses osteoclastogenesis and prevents ovariectomy-induced bone loss by regulating RANKL-mediated NF-κB and MAPK signaling pathways,” JBMR, 2011; 26(3):644–656.
21. Banno N, Akihisa T, Tokuda H, et al, “Anti-inflammatory and antitumor-promoting effects of the triterpene acids from the leaves of Eriobotrya japonica” BPB, 2005; 28(10):1995–1999.