

evra®



# SOLAN- RED®

dry extract of *Solanum aethiopicum* (red eggplant from Basilicata)

#### **Cardio-vascular prevention**

- anti-hyperlipidemic
- hypoglycemic
- anti-hypertensive

#### **Healthy aging**

- antioxidant
- anti-inflammatory
- control of body weight
- source of trace elements

#### **Skin health and beauty**

- anti-free radicals
- anti-inflammatory

## SOLANRED® PRODUCT DATA SHEET:

**Product code:** SSDSLNAF0500500A

**Scientific name:** Solanum aethiopicum L.

**Common name:** Red eggplant from Basilicata

**Drug:** fruit.

**E / D ratio:** 1/20.

**Extraction solvent:** water.

**Supporting excipient:** maltodextrin.

**Origin of the drug:** Italy (Basilicata).

**Country of production of the extract:** Italy.

**Production plant:** Evra srl Benefit Company - Lauria (PZ).

**Organoleptic characteristics:** light orange to light brown fine powder.

**Suggested dosage:** 450 mg x 2 times a day.

**Solubility:** soluble in water.

**Particle size:** 90% through 1000 µ.

**Tapped density:** about 0.5 g / ml.

**Loss on drying (105 ° C x 3 h):** 5% max.

**Heavy metals:** Pb <3 ppm; Cd <1 ppm; Hg <0.1 ppm.

**Residual solvents:** compliant with Dir. 32/2009 / EC.

**Pesticides:** compliant with Reg. 396/2005 / CE and subsequent modifications.

**Polycyclic aromatic hydrocarbons:** compliant with Reg. 1933/2015 / EC.

**Aflatoxins:** Aflatoxin B1 <5 ppb Total aflatoxins (B1, B2, G1, G2) <10 ppb.

**Total aerobic bacterial count (TAMC):** 50000 CFU / g max.

**Total yeasts and molds (TYMC):** 500 CFU / g max.

**Pathogens:** Salmonella absent / 25 g; E. coli absent / 1 g.

**Enterobacteriaceae:** 100 CFU / g max.

Non-irradiated product.

It does not contain GMOs (Reg. 1829 and 1830/2003 / EC).

It does not contain traces of BSE / TSE or products of animal origin.

**Melamine:** compliant with Reg. 594/2012 / EC.

It does not contain any of the allergens included in Annex II of Reg. 1169/2011 / EC.

Product free from ethylene oxide residues.

**Storage:** in a cool place, in the original containers, well closed, away from light, humidity and direct heat sources.

**Minimum shelf life:** 36 months from the date of production.

Product suitable for vegans.

EU food grade certified product

## BIBLIOGRAPHY:

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[2] Ferreira-Santos P et al. Extracts from red eggplant: impact of ohmic heating and different extraction solvents on the chemical profile and bioactivity. Front. Sustain. Food Syst. 5 2021. <https://doi.org/10.3389/fsufs.2021.804004>.

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[4] Akinwunmi KF. Evaluation of anti-obesity potentials of phenolic-rich fraction of Solanum aethiopicum L. and Solanum macrocarpon L. on diet-induced obesity in Wistar rats. European J Med Plants 2018; 26(1): 1-10

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[6] Nwanna EE, Ibukun EO, Oboh G. Effect of some tropical eggplant fruits (Solanum spp.) supplemented diet on diabetic neuropathy in male Wistar rats in vivo. Func. Foods Health Dis. 2016; 6(10): 661-676.

[7] Scorsatto M et al. Effect of Eggplant Flour (Solanum melongena L.) associated with hypoenergetic diet on antioxidant status in overweight women - a randomised clinical trial. Int J Food Sci. 2019; 54:2182-189.

[8] Chinedu SN, Eboji OK, Rotimi SO. Effects of Solanum aethiopicum fruit on plasma lipid profile in rats. Adv. Biores. 2013; 4(4): 79-84.

[9] Nishimura et al. Antihypertensive effects of orally administered eggplant (Solanum melongena) rich in acetylcholine on spontaneously hypertensive rats. Food Chem. 2019; 276: 376-382.

[10] Nishimura M et al. Daily ingestion of eggplant powder improves blood pressure and psychological state in stressed individuals: a randomized placebo-controlled study. Nutrients 2019. 11(11): 2797.

[11] Anosike CA, Obidoa, Ezeanyika. Membrane stabilization as a mechanism of the anti-inflammatory activity of methanol extract of garden egg (Solanum aethiopicum)LUS. DARU J. Pharm. Sci. 2012 (20):76.

The red eggplant from Basilicata is a variety of *Solanum aethiopicum* L., a species native to India that spread first to the Middle East and Africa, then to South America. It was domesticated in Italy during the last century in the district of the Pollino National Park. Compared to its congeners, it has a fruit (berry) resembling a tomato in size, shape and red-orange streaked green epicarp. It is a complex and highly variable species in terms of morphology, phytochemical composition and nutrients. In continental Europe *S. aethiopicum* has been cultivated only in Basilicata and, marginally, in Belgium only since a few years. The wide diffusion has consolidated various ethno-botanical uses in relation to the different anthropological and environmental contexts. In the African tradition, for example, the fruits, leaves and roots are used in various ways to treat: dysentery, intestinal colic, hypertension, menstrual disorders, diabetes, dyspepsia, gastroesophageal reflux, asthma, rhinitis and other conditions [1].

Traditional European medicine attributes hypotensive and metabolic-regulating effects to the fruits of *S. aethiopicum* and their preparations; they are also considered among the vegetables with the greatest supply of nutrients (especially amino acids) as well as trace elements and antioxidants.

**Scientific name:** *Solanum aethiopicum* L.

**Common names:** red eggplant, African eggplant, scarlett eggplant, garden eggplant.

**Composition of the phyto-complex of *S. aethiopicum* fruits:** phenolic acids (chlorogenic, rosmarinic, p- and o-coumaric, syringic, ferulic, caffeic, gallic); ellagic acid; flavonoids (naringin, hesperidin, apigenin, kaempferol, taxifolin); resveratrol; alkaloids, carotenoids, vitamin C [2].

**Drug:** whole fruit (berry).

**Origin of the drug:** Italy (Basilicata).

**Characteristics of the extract:** aqueous dry extract with E / D ratio = 1/20, produced in a small chain in the EVRA srl Benefit Company manufacturing plant in Lauria (PZ).

**Claim (DM 10.08.2018):** Supportive and restorative action. Regularity of blood pressure.

**Composition of Solanred®:** The extract of Solanred® red eggplant from Basilicata has been characterized in its phytochemical and nutritional profile. The phenolic fraction, more involved in the biological actions of the phytocomplex, mainly contains: acids (chlorogenic, caffeic, rosmarin, p- and o-coumaric, ferulic, el-

lagic) and flavonoids (kaempferol, taxifolin, naringin, hesperidin) [2]. The total polyphenol content (Folin-Ciocalteu method) is 77 mgEq of chlorogenic acid / g [3]. The identified amino acids are: aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, valine, isoleucine, leucine, tyrosine, phenylalanine, histidine, arginine. The share of minerals and trace elements includes: calcium, potassium, sodium, magnesium, chromium, iron, phosphorus, iodine, copper, selenium, zinc, manganese.

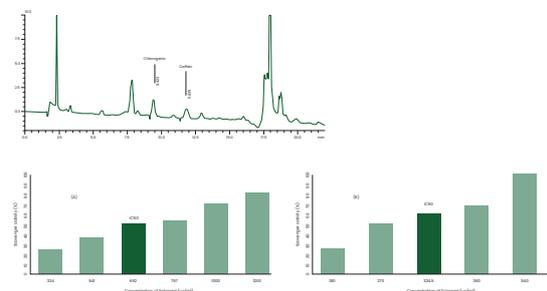
With a test simulating gastrointestinal digestion *in vitro*, it has been shown that some minerals in Solanred® are more bio accessible than in a corresponding control sample [3]. Under the conditions of the experiment, the release of selenium (x 7.2 times), chromium (x 3.2 times) and potassium (x 3.4 times) increases; it is possible that, due to the effect of the natural matrix, this may also extend to the other minerals and trace elements present in the product.

Sample	Se (%)	Cr (%)	K (%)
Solanred®	36±0,2	48±0,3	40±0,5
Control	5±0,6	15±0,5	12±0,4

**Tab. 1: *in vitro* increase of the bio accessibility of Se, Cr and K (modified by [3]).**

### IN VITRO ANTIOXIDANT ACTIVITY.

The *in vitro* antioxidant activity of Solanred® was measured with the DPPH and ABTS assays and with the FRAP test. In the three different experimental conditions, the extract showed excellent antioxidant capacity. Parisi et al. [3] measured an IC50 of 692 µg / ml and 324.5 µg / ml for DPPH and ABTS, respectively, while Ferreira-Santos et al. found that the activity of Solanred® in the FRAP test is up to 10 times higher than that measured for six other different eggplant cultivars [2].



**Fig. 1: inhibition (%) of DPPH (A) and ABTS (B) radicals at increasing concentrations of Solanred® (modified from [3]).**

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**SOLANRED®:**  
**PHYTOTHERAPEUTIC**  
**NUTRACEUTICAL IN**  
**METABOLIC SYNDRO-**  
**ME AND IN CONDI-**  
**TIONS OF ALTERED**  
**REDOX BALANCE**



“

**SOLANRED®: CAN REGULATE ABSORPTION OF DIETARY FATS, THE LIPID STRUCTURE OF PLASMA AND REDUCE ADIPOGENESIS**



**HYPOGLYCEMIC AND ANTI-OBESITY ACTION OF SOLANRED®**

- inhibits intestinal  $\alpha$ -glucosidase
- inhibits pancreatic  $\alpha$ -amylase

Various ethno-botanical traditions consider *S. aethiopicum* extracts hypoglycemic; few studies on rats are available in the literature to demonstrate this effect, some performed on leaf extracts and others on different species of eggplant, such as *S. melongena*.

The administration of 400 mg / kg of phenolic fraction of *S. aethiopicum* to obese Wistar rats on a high-calorie diet resulted in a statistically significant reduction ( $p < 0.05$ ) vs placebo in both weight gain and blood glucose [4]. In another work, the addition of 4% and 8% of *S. aethiopicum* fruit to the daily diet of Wistar rats reduced the weight gain of the animals in a dose-dependent manner, by 27.15% and 54.24%, respectively, compared to controls ( $p < 0.05$ ). In the group that had taken 8% of red eggplant, there was also a significant reduction in hepatic glycogen [5]. *S. kumba* and *S. gilo* (two cultivars of *S. aethiopicum*) were shown to be very effective in reducing blood sugar and counteracting hypertension in streptozocin-diabetic rats when added (20% and 40% by weight) to the daily diet of animals. Experimental groups that took African eggplant varieties also improved their antioxidant status by increasing levels of reduced glutathione (GSH), glutathione peroxidase (Gpx), catalase (CAT) and ascorbic acid [6].

Among the few clinical studies available, is worth mentioning the one by Scorsatto et al. [7] involving 186 obese women to test

the effect of adding *S. melongena* powder (13 g / day) to a daily low-calorie diet. The randomized, double-blind, placebo-controlled 4-month study divided the volunteers into a group of obese but metabolically healthy people and one of obese women with clinical dysmetabolism. Compared to the placebo group, all subjects who took *S. melongena* powder in association with the low-calorie diet improved their antioxidant status in a statistically significant way ( $p = 0.044$ ); the improvements were even more significant ( $p = 0.028$ ) taking into account only the group of metabolically healthy women. Furthermore, the administration of the botanical reduced both the waist circumference and the fat mass in the two experimental groups ( $p = 0.01$ ).

*In vitro* Solanred® demonstrated inhibitory activity against two enzymes important for the digestion of polysaccharides: pancreatic  $\alpha$ -amylase and intestinal  $\alpha$ -glucosidase [3]. This action (confirmed by very recent Italian research being published) could therefore, at least in part, support its traditional use as a hypoglycemic nutraceutical and for weight control.

Sample	$\alpha$ -amylase (IC50 $\mu$ g/ml)	$\alpha$ -glucosidase (IC50 $\mu$ g/ml)
Solanred®	530 $\pm$ 0,3	183 $\pm$ 0,5

**Tab. 2: *In vitro* inhibition (IC50) of pancreatic  $\alpha$ -amylase and intestinal  $\alpha$ -glucosidase by Solanred® (modified from [3]).**

**SOLANRED® REGULATES LIPID METABOLISM**

- *in vitro* inhibits pancreatic lipase
- *in vitro* reduces fat deposition in the adipocytes

The phenolic fraction of *S. aethiopicum* (in line with numerous studies carried out on other polyphenolic phytocomplexes and on single molecules of this class) positively interferes with lipid metabolism and can favor a reduction in fat mass. The addition of powdered *S. aethiopicum* fruits to the ordinary diet changed the plasma lipid profile of Wistar rats versus placebo [8].

40 animals (20 males and 20 females) were divided into 4 groups of five specimens and fed for 28 days with: standard diet only or

standard diet with the addition of 4%, 8% and 12% of *S. aethiopicum* powder. The herbal medicine increased HDL cholesterol in a dose-dependent manner (especially in male animals) and reduced VLDL in a non-dose related manner (predominant effect in females). Also in females, there was a statistically significant reduction ( $p < 0.05$ ) in plasma LDL and total cholesterol, while in no animal there was a positive effect on triglycerides.

Solanred® inhibits pancreatic lipase in a concentration-dependent manner *in vitro* (average IC50 = 75  $\mu$ g / ml) and can help reduce the hydrolysis of triglycerides and the absorption of dietary fats [3].

The anti-adipogenic effect of Solanred® has instead been demonstrated on cell cultures of 3T3-L1 pre-adipocytes in which the addition of the extract to the culture medium reduces the deposition of fat compared to controls [3].

## SOLANRED® HAS ACE INHIBITORY ACTION IN VITRO WITH IC50 = 20±0.4 G/ML.

### SOLANRED® AND ANTI-HYPERTENSIVE EFFECT

- *in vitro* inhibits the renin-angiotensin converting enzyme (ACE)

Various species of eggplant have traditional health indications as a remedy for hypertension; *S. aethiopicum* is no exception, so much so that Annex I of the Ministerial Decree 10.08.2018 reports this claim for the fruits of the plant. Extracts of *S. melongena* have shown in spontaneously hypertensive rats a combination of ACE-inhibitory action, NO-mediated vasodilation and indirect sympatholytic effect due to the presence in the phytocomplex of good quantities of acetylcholine (ACh) [9]; this mediator, before being inactivated by hydrolysis, would act on the gastro-intestinal M3 muscarinic receptors by stimulating the parasympathetic transmission system.

The anti-hypertensive effect of *S. melongena* extracts was also verified in a double-blind placebo-controlled clinical study on 100 subjects diagnosed with chronic stress and high-normal blood pressure or grade I hypertension. The subjects of the experimental group took an eggplant powder containing 1.2 and 2.3 mg / day of ACh for 12 weeks.

The herbal medicine reduced the diastolic after 8 and 12 weeks in the normal-high blood pressure group and, after 12 weeks, the systolic + diastolic in the 1st degree hypertensive group [10]. The anti-hypertensive effect of Solanred® is also supported by the *in vitro* inhibition of the renin-angiotensin-converting enzyme (ACE) [3] in line with what was found in other extracts of *S.*

### SOLANRED®: ANTI-INFLAMMATORY ACTION.

- *S. aethiopicum* extracts reduce capillary permeability and leukocyte migration in a *in vivo* models of inflammation.

The eggplant extracts would interfere with the mechanisms of inflammation through the antioxidant effect, modifying the expression of cellular transcription factors that regulate the cascade of pro-inflammatory cytokines and stabilizing cell membranes. The hypotheses on these effects arise from acquisitions of traditional medicine that show a high consumption of these vegetables correlated with an improvement in arthritic symptoms and edema. A pre-clinical study was conducted on rats and on human erythrocytes *ex vivo*, with the aim of demonstrating

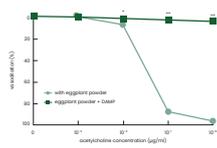


Fig. 3: Concentration-dependent effect of *S. melongena* powder on the aorta of spontaneously hypertensive rat, in the presence and absence of 4-DAMP (selective inhibitor of the muscarinic receptor M3). Modified from [9].

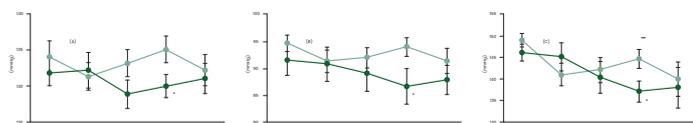


Fig. 4: Effect of *S. melongena* powder on the systolic blood pressure of all subjects included in the study (A) and of the systolic (B) and diastolic blood pressure (C) in those with grade I hypertension. Modified from [10].



Fig. 2: Solanred® at a concentration of 20 µg / ml inhibits of 50% accumulation of intracellular lipids in 3T3-L1 pre-adipocytes (Red Oil or coloring). Arrows indicate fat droplets. Modified from [3].

that methanolic extracts of *S. aethiopicum* can reduce capillary permeability and leukocyte mobilization (induced with agar) in experimental models of inflammation [11].

25 Wistar rats were divided into 5 groups: a negative control group (placebo), a positive control group (indomethacin), three treatment groups (100-200-400 mg / kg *S. aethiopicum* extract). The percentage of inhibition of vascular permeability was: 21 ± 3.39, 25 ± 1.92 and 60 ± 3.81, respectively, for the dosages of 100, 200 and 400 mg / kg of the extract. The inhibition of agar-induced leukocyte migration was: 23 ± 2.17, 26 ± 1.58 and 32 ± 1.58, respectively, for the doses 100, 200 and 400 mg / kg of extract. At the concentration of: 100, 200, 400, 600 and 800 µg / ml the product also significantly inhibits the thermally induced lysis of human erythrocytes, at values of: 66.46 ± 2.89, 65.14 ± 4.58, 46.53 ± 2.52, 61.88 ± 4.51 and 86.67 ± 3.06.

These results show that *S. aethiopicum* extracts have anti-inflammatory action *in vivo* and *in vitro* and can reduce tissue damage in inflammatory processes. In the authors' interpretation, the protective effect against the cell lysis of erythrocytes is indicative of a stabilizing action of the membranes, in particular the lysosomal ones, which are very similar to erythrocytes. This effect could attenuate the release of enzymes and lysosomal mediators that feed the inflammatory mechanism; an action couples with the inhibition of the migration of leukocytes, probably due to an interference with the adhesion proteins caused by the phenolic complex of *S. aethiopicum* (other natural compounds such as oleuropein, for example, are well known for inhibiting the attachment of leukocytes to VCAM and ICAM proteins).

Already after 30 days of administration, the experimental group of patients achieved a significant reduction in visceral fat compared to those who took placebo (-12.4% vs -2.2%); this difference remained statistically significant until the end of the treatment period.

### SOLANRED®: IN VITRO CYTOTOXICITY TEST.

- Solanred® does not reduce cell viability.

Solanred® has been subjected to various *in vitro* cytotoxicity tests which gave negative results [2-3].

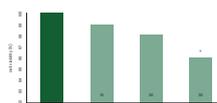


Fig. 5: *in vitro* test of the effect of Solanred® on the cell viability of 3T3-L1 pre-adipocytes. Modified from [3].

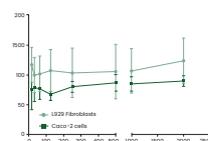


Fig. 6: *in vitro* test of the effect of Solanred® on the cell viability of L929 fibroblasts and Caco-2 cells. Modified from [2].

evra®

info@evraitalia.it  
Località Galdo Zona Industriale  
Lotto 20 85044 Lauria (PZ)  
www.evraitalia.it  
+39 0973 624 687

