Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 697-701
Received: 02-09-2019
Accepted: 04-10-2019

Lokesh Madineni
Post-Graduate Student, Department of Applied Engineering Vignan's Foundation for Science, Technology and Research University (VFSTRU), Vadlamudi, India

K Ravi Chandra Charyulu
Post-Graduate Student, Department of Applied Engineering Vignan's Foundation for Science, Technology and Research University (VFSTRU), Vadlamudi, India

B Harish Babu
Assistant Professor, Department of Applied Engineering, Vignan's Foundation for Science, Technology & Research, Guntur, Andhra Pradesh, India

Ayyana K
Assistant Professor, Department of Applied Engineering, Vignan's Foundation for Science, Technology & Research, Guntur, Andhra Pradesh, India

Ashok Chakravarthy
Post-Graduate Student, Department of Food Technology, National Institute of Food Technology Entrepreneurship and Management, Haryana, India

Corresponding Author:
Lokesh Madineni
Post-Graduate Student, Department of Applied Engineering Vignan's Foundation for Science, Technology and Research University (VFSTRU), Vadlamudi, India

Experimental analysis of Moringa leaf thin layer drying modeling

Lokesh Madineni, K Ravi Chandra Charyulu, B Harish Babu, Ayyana K and Ashok Chakravarthy

Abstract
The use of synthetic antioxidants is limited due to their toxic properties. The purpose of this study is to study the antioxidant activity of medicinal and aromatic plant extracts and to identify alternative natural and safe sources of food antioxidants, especially of vegetable origin.
Research work was conducted to study the rehydration of various temperatures and dried moringa leaves. The moringa leaves are widely known for their cosmetic properties, which have anti-carcinogenic, anti-inflammatory, analgesic and antipyretic properties. To study the effect of different drying conditions on the kinetics of moringa leaves, they were dried at 50, 60 and 70 °C.
The drying of the Moring leaves was visible during the fall rate and at higher temperatures the drying was faster. Among the mathematical models studied, the Newtonian model has satisfactorily characterized the resistance to drying with the highest values of r2. The actual moisture diffusivity of the Moring leaves increases as the temperature of the drying air increases.

Keywords: Moringa leaves, drying, cosmetic agent

1. Introduction
Moringa (*Moringa oleifera* Lam) is an indigenous Indian herb that is proven to be known in tropical and subtropical countries. Other terms used by Moring include horseradish tree, Mulangay, Mlonge, Benzolive, Drumstick tree, Sajna, Kelor, Saijihan and Marango. *Moringa oleifera* Division from the Kingdom: Plantae, Division: Magnoliphyta, Class: Magnoliopsida, Order: Brassicales, Family: Moringaceae, Genus: Moringa, Species: *M. oleifera*.
Moringa oleifera is one of the vegetables of the order Brassica and belongs to the family Moringaceae. Moringaceae is a genus of 13 known species. *Moringa oleifera* is a small tree native to the Himalayan regions of northwestern India and is now native to many island and South American regions. Traditionally, in addition to being used daily by the inhabitants of these regions, Moringa is also widely known and used for her health. It has earned it the name of a "miracle tree" among municipalities, thanks to its incredible healing ability for various ailments and even some chronic illnesses. Due to different applications, different studies have been carried out to isolate bioactive compounds from different parts of plants. Therefore, herbal remedies, or also known as phytomedicine, remain reliable and are widely used as one of the cost.
For centuries and in many cultures around the world, Moringa medicine has been used to treat asthma, blackheads, blood impurities, bronchitis, phlegm, chest pain, cholera and many other diseases. *Moringa oleifera* antipyretic, contraceptive, antiepileptic, diuretic, hypercholesterolemic, renal, anti-diabetic and hepatoprotective measures. It has long been labeled with its high cosmetic value, which has been widely believed to be used in a variety of health products, including moisturizers and body and hair conditioners, in recent years. Moringa oil has also been discovered to be used in skin ointments since in Egypt.

2. Review of Literature
Lawsonia inermis is a commercially important medicinal plant used since ancient times. Lawsone is 2-hydroxy-1, 4-naphthoquinone, the main meringue pigment commonly used as a natural dye to traditionally color skin and hair.

2.1. Pharmacological properties of *L. inermis*:
Several researchers have reported different antibacterial activity of *L. inermis* in different *in vitro* and *in vivo* test models. Moringa leaves, flowers, seeds, stem bark, roots have antioxidants, anti-diabetic, hepatoprotective, hypoglycemic, antimicrobial, antitumor and healing properties.

2.2. Moring's antibacterial studies

Ethanolic extracts of 20 plant species used by traditional Yemeni healers for the treatment of infectious diseases have been tested for antibacterial activity against both Gram-positive and Gram-negative bacteria. *L. inermis* ethyl acetate extract was found to be most active against all bacteria in the test system [12]. Of the forty-five species of the 29 plant families used in traditional medicine by the Iranian population, it had antibacterial activity against eleven species of bacteria, and Moringa had strong activity against *Bordetella bronchiseptica*. These results indicated that *L. inermis* can be used to treat bacterial infections [13]. Crude extracts of fresh, dried leaves and Moringa seeds have been studied for their antimicrobial activity against three standard strains. Dried Moringa leaves have shown the best antimicrobial activity *in vitro* and especially against *Shigella sonnei* [14]. Genotoxic studies with the main constituent of the morginga indicate that it was a weak bacterial mutagen for *Salmonella typhimurium* strain TA98 and more mutagenic for strain TA2637. He suggested that hydroxylnatacinone does not pose a genotoxic risk to the consumer [21].

Aspergillus niger was treated with aqueous extract and chloroform from *L. inermis* leaves using *in vitro* agar and diffusion techniques. The extract inhibits the growth of all microbes except *C. albicans*. Overall, a study by [8] suggests that moringa can be effective in managing wound infections. The antibacterial activity of methanolic extract of *L. inermis* was investigated by agar well diffusion method using S. aureus (MTCC 087), *E. coli* (MTCC 729), *K. pneumonia* (MTCC 432), *P aeruginosa* (MTCC 1688) and *P. mirabilis* (MTCC 425) from [11]. Water antibacterial activity, ethanol, methanol, ethyl acetate and *Lawsonia inermis* Linn leaf chloroform extracts were tested against bacterial standard strains (*Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonasaeuroginosa*, *Proteus mirabilis*, *Salmonella* typhi, *Vibrio cholerae*, *Staphylococcus aureus* and AmpC β-lactamases which produce *Proteus mirabilis*). Solvents of *L. inermis* leaf extracts showed profound antibacterial activity against the bacterial pathogens tested [15]. Moringa samples from different regions of Oman have shown antibacterial activity against a wide range of different bacterial strains with the highest antibacterial activity against *P. aeruginosa* organisms [14].

Moringa leaf extracts show significant antimicrobial activity on almost all microorganisms tested (S. aureus, Bacillus spp., *K. pneumonia*, Proteus spp., *E. coli*, *P. aeruginosa* and *Enterococcus* spp.), Except for the water extract which showed the least effect. On most bacterial samples tested [16]. Effect of water extract, ethanol extract fractions and leaf fractionated antibacterial activities on *Staphylococcus aureus*, *Proteus vulgaris*, *Streptococcus pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, *Streptococcus pyogenes*, *Salmonella* typhi and is [22].

2.3 Antifungal research on moringa

[17] Reported in their studies that leaf extract of *L. inermis* developed fungicidal activity against *Trichophyton mentagrophytes* and *Candida albicans*. Among the fifty-two selected plants, *Lawsonia inermis* and 10 other plant species, the water extract showed significant antifungal activity against one or other of the tested *Aspergillus* species [18].

2.4 Antiviral studies on moringa

Moring definitely has antiviral effects that have become clear from its effects on warts, whitlow and herpes simplex. Moringa has traditionally been tried many times, especially for warts that are resistant to cryo (liquid nitrogen) treatment, and has proven effective on giant warts, 1.5x1.5 cm per child's thumb, which are resistant to all types of treatment, eventually the child turned to the plastic surgeon to perform the operation, "we tried it on Moring, applied it every other day at night, and after a few weeks it completely disappeared." Moringa was found to be very useful, especially in several wars. Moring warts were applied as a paste. Another proven and successful effect of moringa on viral infections was noted after its application to herpes treatment; it dried blisters early, prevents sores and crust and prevents secondary infection. This Moring antiviral effect is very promising and should be explored in more detail; could be used as a cure for AIDS. It's natural, inexpensive, and doesn't seem to have any side effects, even if taken by oral route.

In *L. inermis*, the ethanol-soluble fraction showed very potent activity against Sembiki forest virus (SFV) in Swiss mice and chick embryo models, showing 100 to 65% activity against the virus after 10-25 days [19].

2.5 Moring antioxidant activity

2-Hydroxy-1, 4-naphthoquinone (HNQ; Lawsone, CAS 83-72-7) is the major coloring component present in the natural plant Moringa (*Lawsonia inermis*). The percent formation of superoxide anion (O_2.) E hydrogen peroxide (H_2O_2), measured in 100 µl Mphenanthridine with guinea pig aldehyde oxidase, was measured and found in the range of 6-10% and 85-90%, respectively. The modulator effect of 80% ethanol extract of *L. inermis* leaves on phase I and II metabolic enzymes, antioxidant enzymes, glutathione content, lactate dehydrogenase and lipid peroxidation in Swiss albino mice liver. Specific activity of hepatic glutathione S-transferase and DT-diaphorase was increased above baseline when treated with *L. inermis* extract. Another study was conducted to evaluate the effect of water and methanol extracts of *L. inermis* extract on cell toxicity and chromium (VI) -induced DNA.

2.6 Moring's antidiabetic activity

Ethanolic extract of *L. inermis* (70%) showed significant hypoglycaemic and hypolipidemic activity in mice with diabetes caused by alloxan after oral administration. Feeding with 0.8 g/kg of *L. inermis* extract reduced normal glucose, cholesterol and triglyceride levels [20].

2.8. Protein morphology suppressant activity

Plant tissue ethanol extract was evaluated *in vitro* for protein glycation inhibitory activity using a bovine serum albumin and glucose sample system (Monique *et al*, 2005). The extract and its ingredients had a significant effect on the protein damage caused by the free radical generator in the *in vitro* test system. This was found by [23] found that alcoholic extract, licorice and gallic acid significantly inhibit the formation of products based on improved glycerides (AGEs), with inhibition of 77.95%, 79.10% and 66%., 98% at 1500 µg / ml, 1000 µg/ml and 1000 µM, respectively. The components of *L. inermis* are confirmed to be glycation inhibitors.

2.9 Moringa wound healing

Plant ethanol extract (200 mg/kg) was used to evaluate wound healing activity in rats using excision, incision and dead site wound models. The topical application was in the case of a cut-out trauma model. Whereas oral treatment was performed with a cut and wound model in the dead room.

Extract of *L. inermis* showed high wound contraction rate, decrease in epithelialization period, high resistance to skin rupture, significant increase in granulation tissue weight and hydroxyproline content [24]. Tissue histology studies showed a well-organized collagen band, more fibroblasts and a slight increase in inflammatory cells compared to controls showing inflammatory cells, poor collagen fibers and fibroblasts. These results suggested the use of *L. inermis* in wound healing (Nayak *et al.*, 2007). Chloroform and aquatic plant extracts were able to inhibit the growth of microorganisms that are involved in causing burn infections [8].

2.9.1 Anti-inflammatory activity of Moringa

The isoplumbagins isolated from the bark of the root and the root of *L. inermis* and legisarol were tested for anti-inflammatory activity against carrageenan-induced paw edema in rats. The results showed that isoplumbagin had significant activity and was compared to phenylbutazone [25]. The butanol and chloroform fractions have shown potent anti-inflammatory, analgesic and antipyretic effects in that the aqueous fraction of the crude ethanol extract of *L. inermis* is dose-dependent [12].

3. Material and methodology

The experiments were conducted at the Vignan's Foundation for Science, Technology and Research, a guiding model. Henna leaves were collected from Angalkuduru village near Tenali in Andhra Pradesh. To study the drying resistance of henna leaves, henna leaves were dried in a tray dryer.

3.1. Preparation of the sample

Henna leaves were removed in the morning for each experiment. Leaves harvested prior to collection are cleaned and graded for stems and unwanted waste. The known sample weight (200 g) was weighed and evenly distributed in thin layers inside the drying vessels.

Required equipment

3.1.1. Tray Dryer

The tray dryer consists of a stack of trays or several tray trays placed in a large, insulated chamber in which hot air is circulated with specially designed fans.

3.1.2 Fan and motor

Depending on the model, the door is equipped with sliding hinges, lockable plugs and well-balanced large propeller seals with a fan mounted inside the chamber with a suitable shaft and a double bearing with an electric motor.

3.1.3 Heaters

Inside the enclosure are supplied "U" tubular heaters for maximum heat transfer. The steam heated models are equipped with flange type steam radiators.

3.1.4 Control Panel

The control panel box consists of a group of contractors, 7 switches on, neon lamps with digital controllers and control buttons integrated in the control panel.

3.1.5. Moisture meter

- A moisture meter is used to measure the percentage of water in a given substance.
- The moisture content of freshly cut logs may be 80% or more depending on the substance.
- The minimum moisture content that can usually be obtained by air drying is about 12-15%
- The initial and final moisture content of henna leaves can be obtained using a moisture meter
- Trays can run in and out of the chamber.

3.2. Drying tray

A conventional tray dryer with 9 trays was used for drying Henna leaves. The leaves were placed on trays separated in one layer and dried at 50, 60 and 70 °C. Weight loss of sample due to moisture removal was recorded with drying time. Using the data, the moisture content reduction with drying time was calculated.

3.3. Moisture ratio

The Moisture coefficient was determined using the initial and final moisture contents for each time interval. The moisture coefficient was determined using the following formula,

$$M.R = \frac{M - M_e}{M_o - M_e}$$

Where,

M = moisture content %(d.b.)

Me = equilibrium moisture content %(d.b.)

Mo = initial moisture content %(d.b.)

M.R. = moisture rate

Experimental work plan for drying of Moringa oleifera leaves

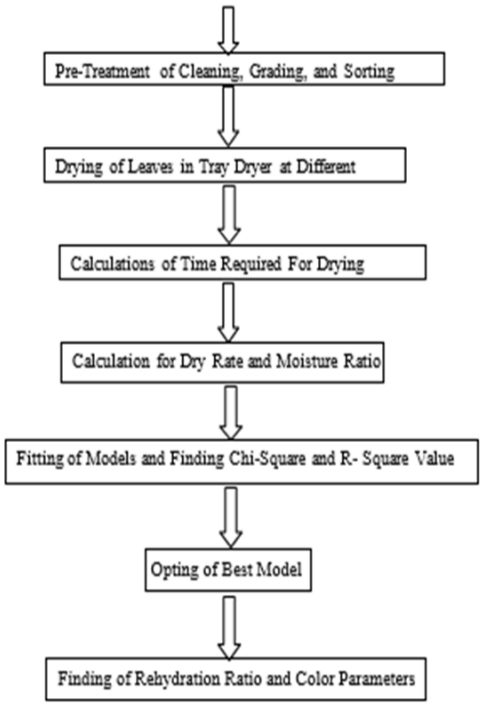

Fig 1: Flow chart of drying of Moringa leaves

4. Results and Discussions

4.1. Drying behavior

The initial moisture content of henna leaves was found to be 74 (% d.b.). The samples shall be dried to a minimum moisture content.

4.1.1 Effect of drying temperature

Drying was performed at 50, 60, and 70 °C. After determining the moisture content of the drying and plotting the drying time (min) and the moisture content (% db), follow an exponential adaptation curve as shown in Figure 1. 4.1, 4.2. and 4.3

4.2 Drying time

The time required for drying different samples at different temperatures was observed. As the temperature rises, the drying time decreases. The time required to dry an unbalanced sample at 50 °C is 600 minutes, which is more than the time required at 50, 60 and 70 °C. The time required to dry the unbalanced sample is 600, 540 and 480 minutes at 50, 60 and 70 °C, respectively.

4.3. Mathematical description of drying data

From the moisture content values at different temperatures, we have calculated the moisture ratio, so the ln (MR) graphs for drying time are plotted as shown in the plots showing different temperatures. In this plot, the equation

$$MR = e^{-kt}$$

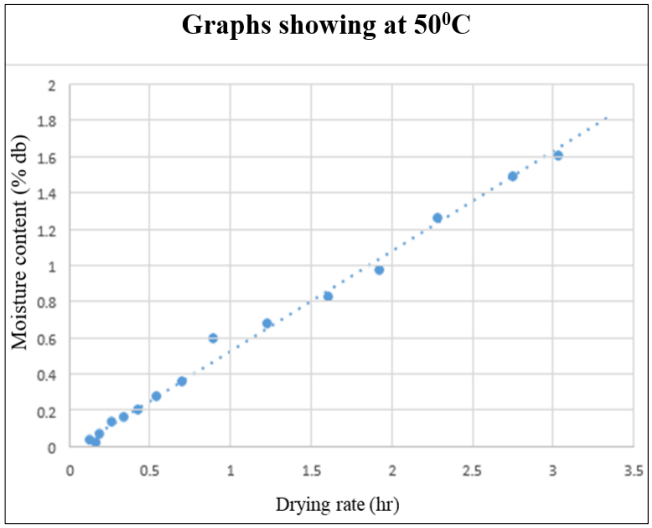

Fig 2: Moisture content vs drying rate (hr) showing at 50 ˚C

The figure 4.1 shows the effect of drying temperature on the moisture content. The figure shows that the drying time at 50 °C is 600 minutes, which is longer than the time required at 50, 60 and 70 °C. The graph shows the time required for drying at temperature.

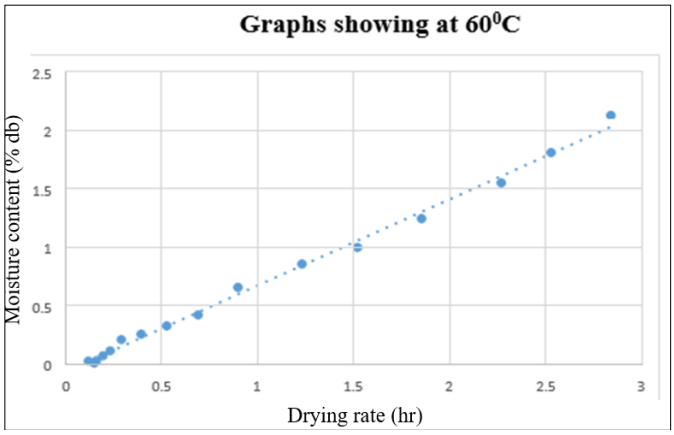

Fig 3: Moisture content vs drying rate (hr) showing at 60 ˚C

The 4.2 figure shows the effect of drying temperature on the moisture content. The figure shows that the drying time at 60 °C is 540 minutes, which is longer than the time required at 70 °C.

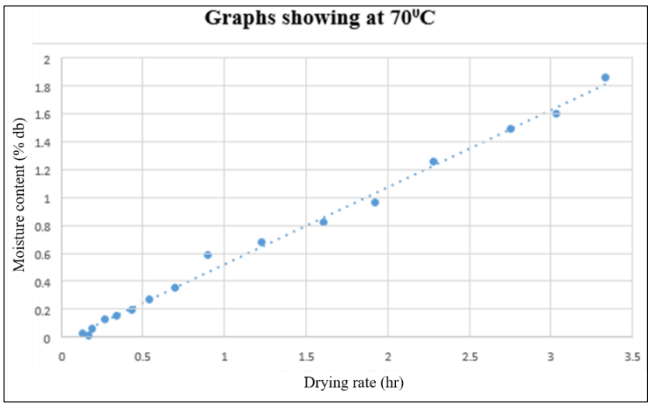

Fig 4: Moisture content vs drying rate (hr) showing at 70 ˚C

The figure 4.3 shows the effect of drying temperature on the moisture content of the bleached sample. The figure shows 480 minutes for drying at 70 °C. The diagram shows the time required for drying at temperature.

5. Summary and conclusion

Henna leaves were sourced locally. The leaves are cleaned to remove contaminants, i.e. dirt, unwanted stems, etc.

Based on the results discussed in Chapter 4, the following conclusions can be drawn.

1. The initial moisture content of the sample is 74% (b.b.).
2. The time needed for drying the sample was 600, 540 and 480 minutes. Drying at 50, 60 and 70 °C.
3. The drying time decreases with increasing drying temperature at 50 °C more but at 60 °C less.
4. The MR = e-kt equation had to fit better to the ln (MR) diagram for drying time (min).
5. Henna is a plant that naturally gifts to people. Each page brings more benefits to people.

References

1. Quattrocchi U. CRC World Dictionary of Plant Names: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, 2000, 1731.
2. Rajangam J, Azahakia MRS, Thangaraj T, Vijayakumar A, Muthukrishan N. Status of production and utilization of Moringa in Southern India. In: The Miracle Tree/The Multiple Attributes of Moringa (Fuglie LJ, ed.). Church World Service, Dakar, 2001.
3. Fahey JW. *Moringa oleifera* Review of medical evidences for its nutritional, therapeutic, and prophylactic properties. Part 1, Trees for life J, 2005; 1:5
4. Fuglie L Dried Moringa leaves. Footsteps, 2001; 46:14.
5. Azuma L, Nakayama M, Koshioka M, Ippoushi K, Yamaguchi Y, Kohata K. *et al*. Phenolic Antioxidants from the Leaves of Corchorus olitorius L. J. Agric. Food Chem., 47: 3963?3966 #11, 1994.
6. Hanna R, Maciej JN, Lapinsky L, Adamowicz L. Molecular structure and infrared spectra of 2-hydroxy -1, 4-naphthaquinone; Experimental matrix isolation and theoretical Hartree-Fock and post Hartree-Fock study. Spec. Act. 1998; 54:1091-1103. #13.
7. Kikuzaki H, Nakatani N. Antioxidant effects of some ginger constituents. J Food Sci. 1993; 58:1407-1410. #14.

8. Muhammad Z, Mustafa AM. Traditional Malay Medicinal Plants. Kuala Lumpur: Fajar Bakti Sdn. Bhd, 1994. #12.
9. Amit SB, Babasaheb NK, Rajkumar VS. A phytopharmacological review on *Lawsonia inermis* Linn. Journal of Pharmaceutical & Life Science. 2011; 2(1):536-541.
10. Anand KK, Singh B, Chand D, Chandan BK. An evaluation of Lawsonia Alba extract as hepatoprotective agent. Planta Medica. 1992; 58(1):22-25.
11. Arun P, Purushotham KG, Jayarani J, Kumari V. *In vitro* Antibacterial activity and Flavonoid contents of *Lawsonia inermis* (Henna). International Journal of Pharmaceutica Technology Research. 2010; 2(2):1178-1181.
12. JR Ali, Hall R, Baker SJ. Paleomagetic data from mezonic phillipine sea plate ophiolite on obi island, eastern indonesia, journal asian earth sciences, 2011; 535-546.
13. Bonjar. Evaluation of antibacterial properties of some medicinal plants used in Iran, Journal of Ethnopharmacology. 2004; 94(2-3):301-5.
14. Habbal O. Antibacterial activity of *Lawsonia inermis* Linn (Henna) against Pseudomonas aeruginosa. Asian Pac. J Trop. Biomed. 2011; 1:173-176.
15. Ramesh K, Gandhi S, Rao V. Clinical profile of human immunodeficiency virus patients with opportunistic infections: A descriptive case series study. Int J App Basic Med Res. 2015; 5:119-23
16. Ramadan Abdelraouf, El Habbasha, El Sayed, Taha M, Refaie Khaled. Effect of Irrigation Water Requirements and Fertigation Levels on Growth, Yield and Water Use Efficiency in Wheat. Middle East Journal of Scientific Research. 2014; 16:441-450. 10.5829/idosi.mejsr.2013.16.04.11733.
17. Mansour Jamal, Beaudry Jennifer, Bertrand Michelle, Kalmet Natalie, Melsom Elisabeth, Lindsay Roderick *et al*. Impact of Disguise on Identification Decisions and Confidence with Simultaneous and Sequential Lineups. Law and human behavior, 2012, 36. 10.1037/h0093937.
18. Satish S, Mohana Devihalli, Raghavendra Mp, Anandarao Raveesha, Ranhavendra D. Antifungal activity of some plant extracts against important seed borne pathogens of *Aspergillus* sp. Journal of Agricultural Technology, 2006, 109.
19. Anwar A, Khan James, Maguire D, George S. Abawi, Satriyas Ilyas. Matriconditioning of Vegetable Seeds to Improve Stand Establishment in Early Field Plantings, J. AMER. Soc. HORT. SCI. 1991; 117(1):4147-1992.
20. Syamsudin I, Winarno H. The effect of Inai (*Lawsonia inermis*) leaves extract on blood sugar level: an experimentally study. Research Journal of Pharmacology. 2008; 2(2):20-23.
21. Kirkland David, Marzin Daniel. An assessment of the genotoxicity of 2-hydroxy-1, 4-naphthoquinone, the natural dye ingredient of Henna. Mutation research. 2003; 537:183-99.
22. Kawo A, Kwa A. Phytochemical screening and antibacterial activity of the aqueous extracts and fractions of ethanolic extracts of *Lawsonia inermis* leaf. Int. Res. J Microbiol, 2011, 2.
23. Anokwuru Chinedu, Anyasor Godswill, Olusola Ajibaye, Fakoya O, Okebugwu P. Effect of Extraction Solvents on Phenolic, Flavonoid and Antioxidant activities of Three Nigerian Medicinal Plants. Nature and Science. 2011; 9(7):9-7.
24. Hamdi A, Porter J, Prasad C. Decreased striatal D2 dopamine receptors in obese Zucker rats: changes during aging. Brain Res. 1992; 589:338-340.
25. Ashima Sen Gupta, Robert P. Webb, A. Scott Holaday, Randy D Allen. Overexpression of Superoxide Dismutase Protects Plants from Oxidative Stress, Plant Physiol. 1993; 103:1067-1073