



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(12): 237-242
© 2022 TPI
www.thepharmajournal.com
Received: 08-09-2022
Accepted: 13-10-2022

Sanket V Sonawane
Department of Food Technology,
Parul Institute of Applied
Science, Parul University,
Waghodia, Vadodara, Gujarat,
India

Kinjalben Rana
Prof., Department of Food
Technology, Parul Institute of
Technology, Parul University,
Waghodia, Vadodara, Gujarat,
India

Corresponding Author:
Sanket V Sonawane
Department of Food Technology,
Parul Institute of Applied
Science, Parul University,
Waghodia, Vadodara, Gujarat,
India

Development of *Moringa oleifera* based chocolate

Sanket V Sonawane and Kinjalben Rana

Abstract

This study intends to offer chocolate to endurance athletes by using the nutritional value of locally available foods. Chocolate, Moringa leaves (*Moringa oleifera*), dried fruits, and flavour essence are utilised. The samples were tested in a food laboratory. Moringa powder was employed in this study for its calcium content, while dried fruits were used for their carbs with a low glycemic index. 100 grammes of developed chocolate includes 13.20 grammes of moisture, 2.56 grammes of ash, 36 grammes of fat, 10 grammes of protein, 38.40 grammes of carbs, and 312 grammes of calcium.

Keywords: White chocolate, *Moringa oleifera*, essence, dry fruits

Introduction

Moringa (*Moringa oleifera*) is a native of the Indian subcontinent that has grown naturalised in tropical and subtropical places all over the world. It can grow well in wet tropics or scorching dry lands, can withstand poor soils, and is not affected by drought (Anwar *et al.*, 2007) [4]. It can withstand a broad range of rainfall, with the lowest annual rainfall needs to be estimated to be 250 mm and maximum annual rainfall requirements estimated to be above 3000 mm (Palada and Changl, 2003) [40]. *Moringa oleifera* is a very nutritious vegetables that are grown in many places, including India, Pakistan, the Philippines, Hawaii, and many regions of Africa (Anwar *et al.*, 2005) [5]. The tree is referred to locally as the Benzolive, Drumstick, Horseradish, Kelor, Marango, Mlonge, Mulangay, Saijihian, and Sajna trees (Fahey, 2005) [17]. Since practically every component of the moringa tree may be utilised for food, medicine, or industry, it is regarded as one of the world's most useful trees (Anjorin *et al.*, 2010) [2]. This tree may enhance nutrition, increase food security, and promote rural development (Hsu, 2006). In most nations where it is not native, there has recently been a significant resurgence of interest in the nutritional benefits of Moringa (Oduro *et al.*, 2008) [31]. According to reports, *M. oleifera* leaves may be consumed fresh, roasted, or dried and kept for several months without suffering any significant loss of nutritional value (Fahey, 2005) [17]. Moringa, which contains several micronutrients, has been claimed to be an excellent source of carotene, protein, vitamin C, minerals, and natural antioxidants such as ascorbic acid, flavonoids, phenolics, and carotenoids (Chumark *et al.*, 2008) [11]. These nutrients are utilised for osmotic correction, as well as to activate enzymes, hormones, and other organic molecules that improve growth, function, and life process maintenance (Anjorin *et al.*, 2010) [2]. The nutritional makeup of the plant is important in terms of nutritional, medicinal, and therapeutic properties (Al-Kharusi *et al.*, 2009) [1]. It is regarded as "mother's best friend" in the Philippines, and its use enhances a woman's milk supply and is occasionally prescribed for anaemia. (Anwar *et al.*, 2007) [4]. Several therapeutic benefits have been attributed to various portions of this revered tree. Almost all parts of this plant, including the root, bark, gum, leaf, fruit (pods), flowers, seed, and seed oil, have been used in South Asian indigenous medicine to treat a variety of ailments, including inflammation and infectious diseases, as well as cardiovascular, gastrointestinal, haematological, and hepatorenal disorders (Siddhuraju and Becker, 2003) [35]. Cusses immune system builds up to battle illness. This includes the production of antibodies to combat the infection. (FAO, 2002) [18]. Such plant versatility as a medication, functional food, nutraceutical, and water purifying potential encouraged us to fill a knowledge gap and publish a full analysis of its pharmacological and phytochemical qualities. High-oleic oils were found in the fatty acid content of *M. oleifera* seed oil (Anwar *et al.*, 2005) [5]. It is also a good source of several tocopherols (-, -, and -). (Anwar and Bhangar, 2003) [3]. It also has pharmacological properties, therefore it has a variety of medicinal purposes that have long been known in the Ayurvedic and Unani medical systems (Mughal *et al.*, 1999) [27]. Antimicrobial (Chuang *et al.*, 2007) [10], anticancer (Bharali *et al.*, 2003) [6], anti-inflammatory, antispasmodic, and diuretic

properties are found in the seeds (Dan Malam *et al.*, 2001) [15]. The *Aedes aegypti* mosquito (Paulo *et al.*, 2009) properties. It aids in the reduction of child mortality, contributes to the region's sustainable development (Ferreira *et al.*, 2008) [19], has antihypertensive (Dahot, 1988) [13], diuretic (Ghasi *et al.*, 2000) [21], antispasmodic "diarrhoea" activity (Dangi *et al.*, 2002) [14], antiulcer (Dahiru *et al.*, 2006) [6], and hepatoprotective (Ruck (Nikkon *et al.*, 2003) [30]. *Pseudomonas aeruginosa* and *Staphylococcus aureus* were found to be inhibited by fresh leaf juice (Caceres *et al.*, 1991) [9]. Furthermore, it has antitumor and anticancer properties (Chumark *et al.*, 2008) [11] and aids in thyroid hormone regulation (Tahiliani and Kar, 2000) [38]. In addition, lowering glucose levels in rabbits (Makonnen *et al.*, 1997) [26]. Peptides of Moringa seeds protect the human skin from environmental influences and combat premature skin aging. With dual activity, antipollution and conditioning/strengthening of hair, the *M. oleifera* seed extract is a globally acceptable innovative solution for hair care (Stussi *et al.*, 2002) [36]. Moring seeds are one of the best natural coagulants discovered so far (Kalogo *et al.*, 2000) [24]. Its extract is used instead of alum by rural women to treat the highly turbid Nile water because of a traditional fear of alum causing gastrointestinal disturbances and Alzheimer's disease (Muyibi, 1994) [28]. Although preliminary studies are, Therefore, the objective of the study was to determine the nutritional value of Moringa leaves and their effects on nutritive and organoleptic test values of chocolate and sesame sweet (halawa Halaia).

In this scenario, the glycemic index (GI) idea was developed, which is a level of food based on its effect on blood sugar levels. Consumption of low-GI foods can ensure continuous glucose release into the bloodstream during the game. This is because low-GI foods are absorbed slowly, resulting in delayed storage. Because muscle glycogen is slowly stored, extra glucose will be available until the end of the game (Welis and Syafrizal, 2009) [39]. Low GI possesses qualities that can cause the digestive process in the stomach to run slowly, resulting in a slower rate of emptying the stomach (gastric emptying rate). This causes a suspension of food that has been digested in the stomach (chyme) to move more slowly into the small intestine, resulting in slower carbohydrate digestion and glucose absorption. Similarly, the majority of glucose uptake in low-GI meals happens in the upper small intestine (duodenum) and the middle section (jejunum). Finally, with these metabolic features, changes in blood glucose levels are typically minor, and low-GI meals can minimise glycemic and insulin reactions. (Hoerudin, 2012) [22]. Moringa leaves are a good source of calcium. Moringa leaves are known as "magic plants" because of their numerous applications, particularly in medicine and nutrition. Fresh Moringa leaves provide at least 1077 mg of calcium per 100 g. (Fahey, 2005) [17]. Fortification of processed cocoa bean products, namely chocolate, is also possible. Some chocolate products, such as dark chocolate, are created from cocoa paste with a little sugar added. White chocolate is manufactured from cocoa butter, sugar, and milk powder, while milk chocolate is formed from cocoa paste, cocoa butter, sugar, and milk powder. There are also couverture chocolates, which are frequently used by professionals in the field to produce pastries or cakes. (Agus, 2012) [37]. Nowadays, athletes desire food that they enjoy and that is also nutritionally beneficial. Local food-based snacks made from cocoa, Moringa, and dry fruits are still hard to get by, especially in Indonesia. As a

result, it must be cultivated as part of an attempt to capitalise on local food potential.

Materials and Method

This study used an experimental approach with a completely randomised design. Data analysis was done using one way ANOVA and the Duncan test. The samples were examined. In a food laboratory, carbohydrate is measured using the Kjeldahl method, fat is measured using the Soxhlet method, crude fibre is measured using the Gravimetric method, ash is measured using the Gravimetric method, moisture is measured using the Gravimetric method, calcium is measured using the AAS method. The ingredients are white chocolate, Moringa powder, dried fruits, and flavour essence, with a formulation comparison in table 1. Heat-resistant glass bowls, scales, chocolate moulds, pans, spoons, aluminium foil, and refrigerators are among the tools used. Steps for making chocolate with Moringa flour and dry fruits include chopped chocolate, flavour essence, or cutting it into small pieces to make it easier to melt. Prepare a pan with a top surface that fits a chocolate bowl, then fill it with about half of the water and heat until it boils. Place the chocolate bowl on top of the pan. This prevents water vapour from combining with chocolate, which causes the chocolate to coagulate quickly and has a bad texture. Melt the chocolate by stirring it. Turn off the fire and mix continually before adding the Moringa flour and cut-up dry fruits. The chocolate should then be poured into a mould and refrigerated until hard. Finally, wrap it in aluminium foil.

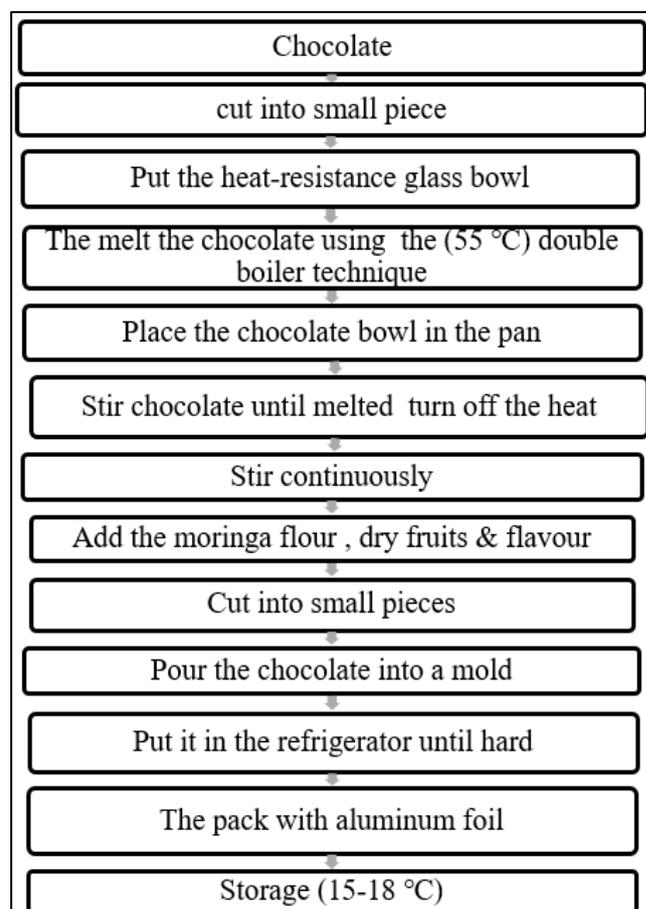


Fig 1: Flow chart for preparation of *Moringa oleifera* based chocolate

Table 1: Formulations of *Moringa oleifera* based Chocolate

Sr. No.	Ingredients	T0	T1	T2	T3
1	Chocolate	100gm	100gm	100gm	100
2	Moringa	0 gm	6gm	11gm	16
3	Dry Fruits	15gm	15gm	15gm	15
4	Essence	1teaspoon	1teaspoon	1teaspoon	1teaspoon

Analysis of chemical properties

The chemical properties like moisture, fat, protein, ash and carbohydrate were analyzed by using standard analytical procedures given by AOAC, International 1990.

Moisture content:

Moisture content was estimated adopting AOAC (1990) [41] method. The following equation was used to measure moisture content.

$$\% \text{ Moisture} = \frac{W2-W3}{W2-W1} \times 100$$

Where,

- W1=Weight of the container with lid, g
- W2=Weight of the sample before drying +weight of the container with lid, g
- W3=Weight of the sample after drying+ weight of the container with lid, g

Ash Content

AOAC (1990) [41] method using muffle furnace was used to determined ash content of the samples. The per cent ash was calculated using following formula

$$\text{Ash content (\%)} = \frac{W3-W2}{W1} \times 100$$

Where,

- W1= Weight of the sample, g
- W2= Weight of the crucible before combustion, g
- W3=Weight of the crucible after combustion, g

Protein content:

Protein content was determined using AOAC (1990) [41] method. The percentage of nitrogen and protein were calculated by the following equation.

$$\text{Protein (\%)} = \frac{Ts - Tbx \text{Normality of acid} \times \text{meq. of } N2}{\text{Weight of sample (g)}}$$

- TS = Titre volume of the sample, ml
- Tb = Titre volume of Blank, ml
- Meq. of N2 = 0.014 and
- % Protein = Nitrogen × 5.7

Fat content

AOAC (1990) [41] method using Soxhlet apparatus was used to determined crude fat content of the samples. The percent of crude fat was expressed as follows

$$\text{Fat content (\%)} = \frac{\text{Final Weight of flask}}{\text{Initial weight of flask}} \times 100$$

Total carbohydrate

Total carbohydrate content of the samples was determined as total carbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 (Pearson,

1976) [42].

$$\% \text{ Carbohydrate} = 100 - (\% \text{ Moisture} + \% \text{ Ash} + \% \text{ Fat} + \% \text{ Protein})$$

Calcium

The calcium contain of the milk chocolate sample was determine according to a method published by the association of analytical communities (AOAC; Method 985.35, 2010) by using an FAAS (PerkinElmer Analyst 700)

Sensory Evaluation

Moringa chocolate was evaluated for different sensory attributes by a group of five panellists. Sensory attributes like appearance, taste, texture, and over all acceptability for all the samples were assessed using nine-point hedonic scale.

Scores to Be Given As Follows

1. Liked extremely – 9
2. Liked very much – 8
3. Liked moderately – 7
4. Liked slightly – 6
5. Neither liked nor disliked – 5
6. Disliked slightly – 4
7. Disliked moderately – 3
8. Disliked very much – 2
9. Disliked extremely – 1

Results and Discussion

The parameters like moisture content, protein content, ash content, fat content, carbohydrates and calcium were evaluated for moringa chocolate and presented in the table 2.

Table 2: Proximate composition of moringa based chocolate

Sr. No.	Parameter	Per 100 g
1	Moisture	13.20 mg
2	Ash	2.56mg
3	Protein	10.00 g
4	Fat	36.00 g
5	Carbohydrates	38.40 g
6	Calcium	312.00 mg

Organoleptic evaluation of moringa chocolates

Sensory evaluation acceptance tests were performed for white chocolates. Which were formulated by addition of granular White chocolate, Moringa flour, Dry fruits and Flavour in different proportions to know the acceptability of products prepared. The acceptance scores were assigning for varies sensory parameter like color, flavor, taste, texture, appearance and overall acceptability.

Table 3: Organoleptic evaluation of moringa based chocolate

Sr. No.	Parameter	T0	T1	T2	T3
1	Colour	7	9	8	7
2	Flavour	7	8	7	7
3	Texture	7	8	7	8
4	Appearance	7	9	8	8
5	Overall acceptability	7	9	8	8

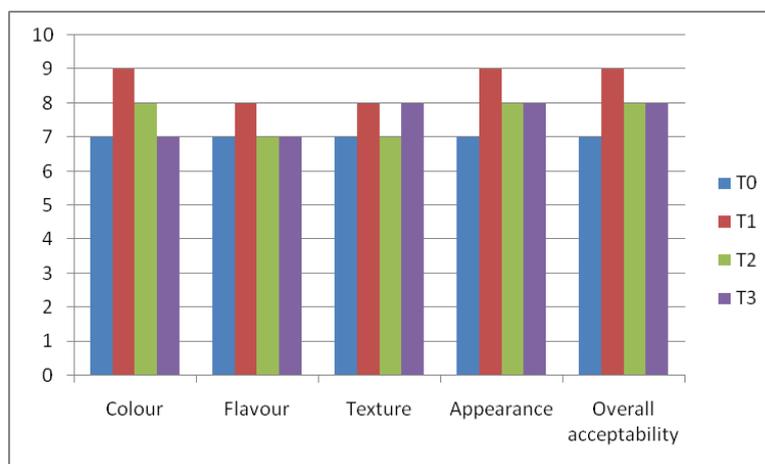


Fig 2: Organoleptic evaluation of moringa based chocolate

It was observed that highest overall acceptability score was awarded for Sample T1 9 because it got acceptable result in colour, flavour, texture, appearance and overall acceptability. So that based on sensory data T1 sample was finalized for the further analysis.

1. Moisture Content

The moisture content of chocolate was evaluated using a 5gm capacity infrared moisture meter. The sample was placed on a plate and attached to the meter. After inserting the sample into the meter, the needle was reset to zero because moisture will cause the needle's reading to alter.

2. Ash Content

The ash content of meals shows the total mineral content. The ash content of chocolate was determined using a muffle furnace, in which a 10 g sample was taken and weighed, and then a dried crucible was weighed. It then burns away the chemical compound in air at temperatures above 500 degrees Celsius for 8 to 10 hours, and then it is cooled in a desiccator and the burning sample is weighed again.

3. Fat Content

The fat content of this product is affected by the addition of dry fruits and chocolate. White chocolate contains a high fat compared to other constituent ingredients. Fat in the body acts as an energy source, especially in sports with moderate intensity in a long time, for example, endurance (Rismayanthi, 2015) [33]. According to Burke *et al.*, (2004) [7] fat is an important source of energy for muscle contraction during endurance sports. High-fat consumption (>30% of total calories) can reduce carbohydrate intake, so muscle glycogen cannot be maintained. According to Fink and Miskesky (2015) [20], the recommended consumption of fat for athletes per day is 20-35% of total energy, which includes 7-10% SFA, 10% MUFA and 10% PUFA.

4. Protein

Protein was determined using the AOAC (1995) Kjeldahl technique, which consists of three steps: digestion, distillation, and titration.

5. Calcium

The greatest calcium content discovered through nutrients analysis is 312 mg. Because Moringa powder has a higher concentration. Moringa provides beneficial minerals, one of which is calcium, according to Mahmood *et al.*, (2011) [25].

Moringa leaves provide at least 2003 mg of calcium per 100 g (Fahey, 2005) [17]. Athletes who engage in high-intensity exercise require calcium intake to preserve bone health and lower the risk of bone injury during training or competition. According to Nguyen (2010) [29] in the NSCA's performance training publication, the athlete's calcium adequacy rate is around the Upper Level (UL).

6. Carbohydrates

Based on the analysis of nutrient found the highest carbohydrate content is 38.40 g. because of the concentration of dry fruits more than other ingredients. Dry fruits contain high carbohydrates with a low glycemic index so it is potentially a food source of energy for endurance athletes (Hoerudin, 2012) [22]. According to Louise Burke and Gerg Cox (2010) [8] the carbohydrate requirement of endurance athletes is 1-4 g per kg of body weight. Carbohydrates play a role in maintaining blood glucose levels and speed of carbohydrate metabolism the body to reduce the occurrence of fatigue in athletes who have endurance, carbohydrates contained in chocolates will be absorbed by the body slowly so that it can become a continuous source of glucose.

Conclusion

According to this investigation, this formulation is the best. 100 grammes of developed chocolate includes 13.20 grammes of moisture, 2.56 grammes of ash, 36 grammes of fat, 10 grammes of protein, 38.40 grammes of carbohydrates, and 312 grammes of calcium. The finished product could serve up to 7 grammes. So it has 0.924 g moisture, 0.179 g ash, 2.52 g fat, 0.7 g protein, 2.69 g carbs, and 21.84 g calcium. It may be stated that this product is a decent nutritional snack for endurance athletes. Health claims may also help to increase industrial competitiveness (Fadlillah *et al.*, 2019) [16]. Chocolate with a high calcium content and a low glycemic index is a relatively discovery in the food business, therefore needs to be developed. So that based on sensory data T1 sample was finalized for the further analysis.

Acknowledgments

The author wishes to thank the Parul University Department of Food Technology, the Dean of the Faculty of Food Technology, the Chair of the Food Technology Study Program, the Food Technology Study Program Lecturers, and the Parents.

References

- Al-Kharusi LM, Imardi MO, Ali A, Al-Said FAJ, Abdelbasit KM, Al-Rawahi S. Effect of mineral and organic fertilizers on the chemical characteristics and quality of date fruits. *Int. J Agric Biol.* 2009;11:290-296
- Anjorin TS, Ikokoh P, Okolo S. Mineral composition of *Moringa oleifera* leaves, pods and seeds from two regions in Abuja, Nigeria. *Int. J Agric Biol.* 2010;12:431-434.
- Anwar F, Bhanger MI. Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. *J Agric Food Chem.* 2003;51:6558-6563.
- Anwar F, Sajid L, Muhammad A, Anwarul HG. *Moringa oleifera*: A Food plant with Multiple Medicinal Uses. *Phytother. Res.* 2007;21:17-25.
- Anwar F, Ashraf M, Bhanger MI. Interprovenance variation in the composition of *Moringa oleifera* oilseeds from Pakistan. *J Am Oil Chem Soc.* 2005;82:45-51.
- Bharali R, Tabassum J, Azad MR. Chemomodulatory effect of *Moringa oleifera* Lam. on hepatic carcinogen metabolising enzymes, antioxidant parameters and skin papilloma genesis in mice. *Asian Pac J Cancer Prev.* 2003;4:131-139
- Burke L, Kiens B, Ivy JL. Carbohydrate and Fat for Training and Recovery. *Journal of sport science.* 2004;22:15-30.
- Burke, Louise and Cox. Greg. Complete Grade to Food for Sport Performance. Australia: Griffin Press; c2010.
- Caceres A, Cabrera O, Morales O, Mollinedo P, Mendia P. Pharmacological properties of *Moringa oleifera*. 1: Preliminary screening for antimicrobial activity. *J. Ethnopharmacol.* 1991;33:213-216
- Chuang PH, Lee CW, Chou JY, Murugan M, Shieh BJ, Chen HM. Anti-fungal activity of crude extracts and essential oil of *Moringa oleifera* Lam. *Bioresour Technol* 2007;98:232-236.
- Chumark P, Khunawat P, Sanvarinda Y, Phornchirasilp S, Morales NP, Phivthongngam L, *et al.* The *in vitro* and *ex vivo* antioxidant properties, hypolipidaemic and antiatherosclerotic activities of water extract of *Moringa oleifera* Lam. leaves. *J Ethnopharmacol.* 2008;116:439-446.
- Dahiru D, Obnubiya JA, Umaru HA. Phytochemical screening and antiulcerogenic effect of *Moringa*. *African Journal of Traditional, Complimentary and Alternatives Medicines.* 2006;3:70-75.
- Dahot MU. Vitamin contents of flowers and seeds of *Moringa oleifera*. *Pak J Biochem.* 1988;21:1-24
- Dangi SY, Jolly CI, Narayana S. Antihypertensive activity of the total alkaloids from the leaves of *Moringa oleifera*. *Pharm Biol.* 2002; 40:144-148.
- DanMalam HU, Abubakar Z, Katsayal UA. Pharmacognostic studies on the leaves of *Moringa oleifera*. *Nigerian Journal of Natural Product and Medicine.* 2001;5:45-49
- Fadlillah HN, Nurkhoeriyati T, Felanesa L, Utomo AW. Study on Functional Ingredients and Claims of Ready to Drink (RTD) Fruit Juice in Modern Retail. *Journal Functional Food and Nutraceutical.* 2019;1(1):13-22.
- Fahey JW. *Moringa oleifera*: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties Part 1. *Trees for Life Journal.* 2005;1:5-30.
- FAO. Improved animal health for poverty reduction and sustainable live hoods. *FAO Animal Production and Health papers*; c2002. p. 153.
- Ferreira PMP, Farias DF, Oliveira JTA, AFFU. Carvalho. *Moringa oleifera*: Bioactive compounds and nutritional potential. *Rev. Nutr.* 2008;21:431-437.
- Fink HH, Mikesky AE. *Practical Applications in Sport Nutrition.* 4th. Dearborn R, Fabery S, editors. United State: Jones & Bartlett Learning. 2015;60-125.
- Ghasi S, Nwobodo E, Ofili JO. Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera* Lam in high-fat diet fed Wistar rats. *J Ethnopharmacol.* 2000;69:21-25.
- Hoerudin. Indeks Glikemik Buah Dan Implikasinya Dalam Pengendalian Kadar Glukosa Darah. *Jurnal Buletin Teknologi Pascapanen Pertanian.* 2012;8(2):81-89.
- Hsu R. *Moringa oleifera* medicinal and Economic uses. International course on Economic botany, National Herbarium, Leiden, The Netherlands; c2006.
- Kalogo Y, Rosillon F, Hammes F, Verstraete W. Effect of a water extract of *Moringa oleifera* seeds on the hydrolytic microbial species diversity of a UASB reactor treating domestic wastewater. *Lett Appl Microbiol.* 2000;31:259-264.
- Mahmood KT, Tahira, Mugal, Ikram UI Haq. *Moringa oleifera*: A natural gift-A review. *Journal of Pharmaceutical Sciences and Research.* 2011;2(11):755-781.
- Makonnen E, Hunde A, Damecha G. Hypoglycaemic effect of *Moringa stenopetala* aqueous extract in rabbits. *Phytother Res.* 1997;11:147-148
- Mughal MH, Ali G, Srivastava PS, Iqbal M. Improvement of drumstick (*Moringa pterygosperma* Gaertn.) – a unique source of food and medicine through tissue culture. *Hamdard Med.* 1999;42:37-42.
- Muyibi S.A. The potential of Zogale (*Moringa oleifera*) seeds as a water treatment chemical. *Niger Soc Engineers.* 1994;29: 27-33.
- Nguyen VH. Calcium for Athletes to Improve Bone Strength and Health. *NSCA's Performance Training Journal.* 2010;9:11-13.
- Nikkon F, Saud ZA, Rehman MH, Haque ME. *In vitro* antimicrobial activity of the compound isolated from chloroform extract of *Moringa oleifera* Lam. *Pak J Biol. Sci.* 2003;22:1888-1890.
- Odoro I, Ellis WO, Owusu D. Nutritional potential of two leafy vegetables: *Moringa oleifera* and *Ipomoea batatas* leaves. *Sci. Res. Essays.* 2008;3(2):057-060.
- Paulo MP, Ferreira FU, Ana Carvalho, Davi Farias F, Nara Cariolano G, Vânia Melo MM., *et al.* Larvicidal activity of the water extract of *Moringa oleifera* seeds against *Aedes aegypti* and its toxicity upon laboratory animals. *Biomedical and Medical Sciences. An. Acad. Bras. Ciênc.* 2009;81(2):207-216.
- Rismayanthi C. Sistem Energi dan Kebutuhan Zat Gizi yang Diperlukan untuk Peningkatan Prestasi Atlet. *Jurnal Ilmu Keolahragaan.* 2015;11(1):109-121.
- Ruckmani K, Kavimani S, Anandan R, Jayakar B. Effect of *Moringa oleifera* Lam on paracetamol induced hepatotoxicity. *Indian J Pharm Sci.* 1998;60:33-35.
- Siddhuraju P, Becker K. Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumsticks tree (*Moringa oleifera* Lam.) leaves. *J Agric Food Chem.* 2003;51:44-55

36. Stussi IA, Freis O, Moser P, Pauly G. Laboratoires Sérobiologiques Pulnoy, France http://www.laboratoiresserobiologiques.com/pdf/Article_HappiAntI Po l2002.pdf. 2002.
37. Sudiby, Agus. Peran Cokelat Sebagai Produk Pangan Derivat Kakao Yang Menyehatkan. *Journal Riset Industri*. 2012;6(1):23-40.
38. Tahiliani P, Kar A. Role of *Moringa oleifera* leaf extract in the regulation of thyroid hormone status in adult male and female rats. *Pharmacol Res*. 2000;41(3):319-23
39. Welis Dan Syafrizal. *Gizi Olahraga*. Padang: Wineka Media; c2009.
40. Palada MC, Chang LC. Suggested cultural practices for Moringa. *International Cooperators' Guide AVRDC*. AVRDC pub. 2003 Mar:03-545.
41. AOAC. *Official Methods of Analysis of the Association of Official Analytical Chemists*, 15th ed. Sec. 985.29. The Association: Arlington, VA; c1990; II.
42. Pearson D. *The chemical analysis of foods*. Longman Group Ltd.; c1976.