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International Journal of Food, Nutrition and Dietetics

Volume 10 Number 2
May– August 2022

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Original Article

International Journal of Food, Nutrition and Dietetics
Volume 10 Number 2, May – August 2022
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.10222.4

Vegan Vs Non-Vegan Diet Practice and its Effect on TSH, Creatinine, bone mass levels Among Older Adults Living in Southeast Asian Countries

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How to cite this article:
Swapan Banerjee, Sulagna Ray Pal/Vegan Vs Non-Vegan Diet Practice and its Effect on TSH, Creatinine, bone mass levels Among Older Adults Living in Southeast Asian Countries/Int J Food Nutr Diet. 2022;10(2):43–48.

Abstract

There are many cases of hypothyroidism, kidney diseases, and poor bone health among older adults in southeast Asia. This study aims to assess the role of two major diet practices that are vegan and non-vegan in response to the increase of TSH (hypothyroidism), creatinine (CKD), and decrease of bone mass due to improper calcium metabolism in the older adult population in SEA countries. A total of 95 patients were included in the study for six months in 2021, suffering from the mentioned health issues. In this descriptive cross-sectional study with a quota sampling method, the participants interested in paid virtual diet consultations were requested for filling out pre-tested open-ended questionnaires related to their dietary habits, medicines, and diagnostic tests before online platform consultations. Jamovi version 2.2.5 as the software was applied for all types of data analysis. An independent sample T was used to analyze the mean difference between dependent variables: levels of TSH, creatinine, bone mass, calcium, and two independent groups of food habits (vegan vs. non-vegan) and gender (male and female). The study found 24 vegans and 71 non-vegans out of 62 females and 33 males above 50 years of patients. Results showed no significance with any test values irrespective of gender or food habits. At the same time, while we compare effect size, the food habits group was associated with a decrease in the value of the outcome: TSH -0.2008, bone mass -0.3299, and -0.3448 (Cohen's d test). Therefore, the study can conclude that improper vegan or non-vegan diets can influence TSH, creatinine, and bone mass among older adults of both sexes in SEA regions.

Keywords: Food habits; Southeast Asian countries; Hypothyroidism; Chronic kidney diseases; Bone mass; Older adult's diet.

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Received on: 29.03.2022
Accepted on: 31.04.2022

INTRODUCTION

The lifestyle diseases are growing gradually in the southeast Asian countries because of improper dietary habits, absence of exercise, and poor mental health. Other factors can also accelerate the comorbidities of such patients.

Thyroid disorders old age is one of the major factors that often decrease T3 and serum thyroid-stimulating hormone (TSH), and serum-free T4 levels usually remain unchanged.

Subclinical thyroid disease, mainly subclinical hypothyroidism, should be considered one of the mandatory treatments for those older adults in any population.[1]

Hypothyroidism: This health issue is one of the most prevalent thyroid diseases caused due to thyroid hormone deficiency that can be fatal if untreated in some severe cases. The most common drug recommended is levothyroxine, while the patients are usually reported with cold intolerance, obesity, lethargy, constipation, irritable bowel syndrome, hoarseness of voice, and dry skin. However, clinical manifestations can differ with sex, age, and other factors.[2] The euthyroid TSH level should be 0.4 -2.5 mIU/L, where T3 and T4 are normal. In subclinical hypothyroidism conditions, the TSH level is 3.0-5.5 mIU/L (T4 normal). At mild hypothyroidism, levels are usually between 5.5-10 mIU/L where T4 level decreases by 20%-30% (T3 may beexpected). In moderate conditions, TSH levels should usually be within 10-20mIU/L (low T4 and T3). In the severe stage, TSH >30mIU/L, with low T4 and T3.[3,4]

Chronic kidney diseases: In a study, it was found that 16 epidemiological studies from four SEA countries that are India, Nepal, Bangladesh, Pakistan, where eGFR was measured to assess CKD. The prevalence startedat 23% in Pakistan and 11% in Nepal using the Modification of Diet in Renal Disease equation (MDRD), and the assessment of eGFR can be done through the equation = 175 x (SCr)-1.154 x. (age)-0.203 x. 0.742 (if female) x. Such prevalence was higher among older adults than the normal population in other southeast Asian countries. The systematic review concluded the high prevalence of CKD in South Asian countries.[5] Chronic kidney disease is one of the significant public health issues for southeast Asian countries because almost 2 billion people suffer from CKD.[6] The main reason is population and poor economic status that affect entire health care costs per capita and budget of respective governments. Further, an increased serum creatinine concentration reduces sanctionsin the glomerular filtration rate (GFR).[7]

Bone health: A study found that many males and females above fifty years have poor bone health. The proper preventive measures should be taken to stop the progression of osteoporosis, often caused due to low bone mass and calcium deficiency.[8] A study showed that bone mineral density (BMD) in the SEA region is less than in Caucasians, buthip fracture rates are not something serious. Vitamin D is a fat-soluble vitamin that helps in calcium homeostasis and plays a significant role in the bones and cartilages' growth, development, and mineral balance.[9] However, BMD and vitamin D are highly correlated with bone mineral content (BMC), also called bone mass. Bone mass is expressed in kilogram, which is found by subtracting muscle mass from the fat-free mass. The bone mass has measureda minimum of 1.95 kg to a maximum of 2.95 kg for females, whereas males should be minimum of 2.65 kg to a maximum of 3.69 kg subject to the age group 50-75 years.[10]

METHODS AND MATERIALS

This is a descriptive cross-sectional study with a quota sampling method having twosubgroups under the gender group, male and female. Similarly, another two sub groups under food habits were considered vegan and non-vegan. Ninety-five participants within fifty to seventy years were included from nine Southeast Asian countries, including India, based on six-month health records of diagnostics tests that are TSH, creatinine, bone mass (kg), and calcium consumption apart from dietary habits. All subjects as international patients consulted by the dietitian for online diet consultations from May to October 2021 through email systems and Google meets platform. A pre-tested open-ended questionnaire was duly filled out and subsequently received from the participants through email before the diet plan. The participants also signed the filled format and consent form following ethical norms. The critical patients admitted to the hospital or just released from the hospital at the start of the study were omitted.

The study's inclusion was exclusively based on four test parameters: TSH, creatinine, bone mass, and calcium consumption level following either vegan or non-vegan diet for long years. We applied Jamovi version 2.2.5 as software for all types of data analysis and making graphs.[11]

RESULTS AND DISCUSSIONS

The study used parametric tests as independent sample T-test selecting groups, using gender (male and female) and food habits (vegan and non-vegan) separately with other dependent variables. The test was used to illustrate descriptive statistics of all diagnostics tests and frequencies of calcium consumption of all the selected samples among nine countries.

Some graphs were prepared to show the relevance irrespective of grouping variables to major testing factors: TSH, creatinine, bone mass (kg) level, and

Ca consumption. Table. 1 shows the mean, median, and standard deviations based upon total samples N=95. Tables 2 and 3 show descriptive statistics irrespective of food habits; 24 vegans and 71 non-vegan who were 62 females and 33 males of above 50 years of patients participated in the study.

A statistical technique for examining the mean difference between dependent variables and two independent groups is an independent sample t-test. An independent samples t-test can determine if two samples from the same population have the same mean. On the other hand, the mean may differ if samples are collected from two separate populations. It's utilized to draw inferences about two populations' means and see if they're similar in this case. As per table 4, we performed all four tests (Student's t, Bayes factor, Welch's t, Mann-Whitney U) under an independent sample T-test that found no significance with any test values irrespective of gender or food habits. At the same time, while we compare effect size, the food habits group is associated with a decrease in the value of the outcome: TSH -0.2008, bone mass -0.3299, and -0.3448 (Cohen's d test). The values justify an opposite direction relationship between the food habits as grouping variables with the respective two variables. It simply denotes that food habits can decrease bone mass and TSH levels in a similar population in SEA countries. However, creatinine calcium consumptions are significant in terms of p values and effect size.

In the study, we also showed graphical presentation (plot-wise) within all four subgroups (gender and food habits) and lab-testing variables as concerned in the study.

Table 1: Descriptive statistics of diagnostics tests of the samples.

Results	TSH	Bone Mass	Creatinine	Calcium consumption
N	95	95	95	95
Mean	5.48	2.96	2.98	1084
Median	5.40	3.00	1.90	1000
Standard deviation	0.653	0.457	1.59	577
Minimum	4.30	2.00	1.00	500
Maximum	7.00	4.10	6.50	2000

Table 2: Descriptive statistics of all tests irrespective of food habits (both types).

Results	Food habits	N	Mean	Median	SD	SE
TSH	Vegan	24	5.39	5.30	0.580	0.1185
	Non-veg	71	5.51	5.40	0.677	0.0803
Bone Mass	Vegan	24	2.85	2.85	0.393	0.0803
	Non-veg	71	3.00	3.00	0.473	0.0561
Creatinine	Vegan	24	3.13	2.70	1.697	0.3465
	Non-veg	71	2.93	1.90	1.563	0.1855
Calcium consumption	Vegan	24	1000.00	1000.00	571.040	116.5631
	Non-veg	71	1112.68	1000.00	580.623	68.9072
Participants	Vegan	24	49.75	50.00	30.438	6.2131
	Non-veg	71	47.41	48.00	26.735	3.1729

Table 3: Descriptive statistics of all tests irrespective of gender.

Results	Group	N	Mean	Median	SD	SE
Participants	Female	62	47.85	49.00	28.337	3.5988
	Male	33	48.27	46.00	26.490	4.6113
TSH	Female	62	5.55	5.40	0.720	0.0915
	Male	33	5.35	5.30	0.486	0.0846
Bone Mass	Female	62	2.92	3.00	0.424	0.0539
	Male	33	3.04	3.00	0.510	0.0887
Creatinine	Female	62	3.05	2.80	1.630	0.2069
	Male	33	2.84	1.90	1.531	0.2665
Calcium consumption	Female	62	1145.16	1000.00	568.195	72.1608
	Male	33	969.70	1000.00	585.494	101.9214

The study mainly aims to observe the connections within four subgroups and dependent variables that are significant diagnostics tests to justify the gender wise and food habit wise relationships among the SEA populations to assess thyroid, kidney, and bone health. However, a large sample size may depict the correct pictures of these health issues. Older adults in any country are prone to lifestyles diseases such as kidney disorders (CKD), osteoarthritis, and HT.

Table 4: Independent Samples T-Test on various tests and degree of freedom vs. effect size irrespective of food habits

	Tests	Statistic	±%	df	p	Tests	Effect Size
TSH	Student's t	-0.819		93.0	0.415	Cohen's d	-0.1935
	Bayes factor	0.325	1.06e-4				
	Welch's t	-0.884		45.8	0.381	Cohen's d	-0.2008
	Mann-Whitney U	779			0.534	Rank biserial correlation	0.0857
Bone Mass	Student's t	-1.397		93.0	0.166	Cohen's d	-0.3299
	Bayes factor	0.561	3.46e-5				
	Welch's t	-1.531		47.2	0.133	Cohen's d	-0.3448
	Mann-Whitney U	687			0.157	Rank biserial correlation	0.1937
Creatinine	Student's t	0.514		93.0	0.608	Cohen's d	0.1215
	Bayes factor	0.273	1.18e-4				
	Welch's t	0.494		37.1	0.624	Cohen's d	0.1189
	Mann-Whitney U	751			0.386	Rank biserial correlation	0.1191
Calcium consumption	Student's t	-0.825		93.0	0.411	Cohen's d	-0.1949
	Bayes factor	0.326	1.06e-4				
	Welch's t	-0.832		40.3	0.410	Cohen's d	-0.1957
	Mann-Whitney U	751			0.356	Rank biserial correlation	0.1191
Participants	Student's t	0.358		93.0	0.721	Cohen's d	0.0845
	Bayes factor	0.257	1.20e-4				
	Welch's t	0.336		35.8	0.739	Cohen's d	0.0817
	Mann-Whitney U	810			0.722	Rank biserial correlation	0.0493

In table 5, the calcium consumption was tabulated for all nine countries. It shows Combodia (7) 500 mg, Indonesia (10) 1000 mg, and Mayanmar (5) 2000 mg calcium consumptions among the total included samples in the study. The mean value is 1084 mg, while 24 vegetarians 1000 and 71 non-

Table 5: Frequencies of Calcium consumption among participants of all nine countries.

Calcium consumption	Countries	Female	Male
500	Indonesia	3	2
	Myanmar	2	0
	Philippines	0	1
	Singapore	0	5
	Thailand	0	0
	Malaysia	4	2
	Cambodia	5	2
	Vietnam	1	4
	India	1	0
1000	Indonesia	7	3
	Myanmar	6	0
	Philippines	2	2
	Singapore	5	0
	Thailand	2	1
	Malaysia	1	0
	Cambodia	4	2
	Vietnam	1	1
	India	1	1
2000	Indonesia	3	0
	Myanmar	4	1
	Philippines	0	0
	Singapore	1	1
	Thailand	1	0
	Malaysia	2	1
	Cambodia	3	1
	Vietnam	2	2
	India	1	1

vegetarians 1113 are mean values as shown in table (2) The data India also shows bone mass mean 2.85 for vegan and 3.0 for non-vegan population.

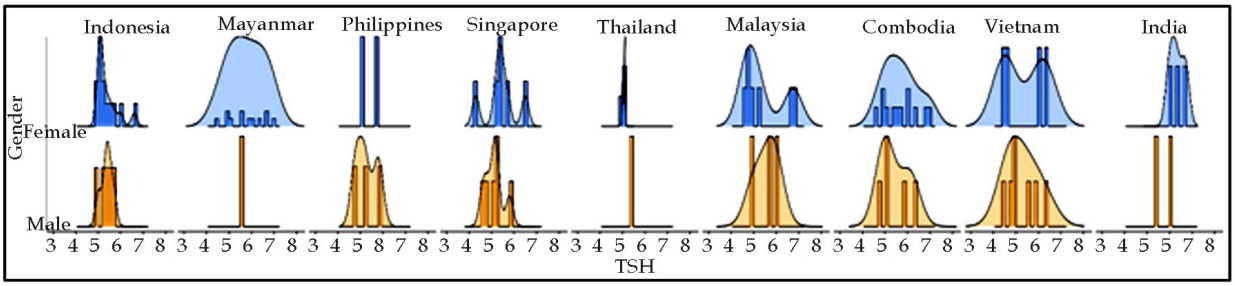

Fig.1: Gender wise TSH level observed in the 95 selected samples from nine countries.

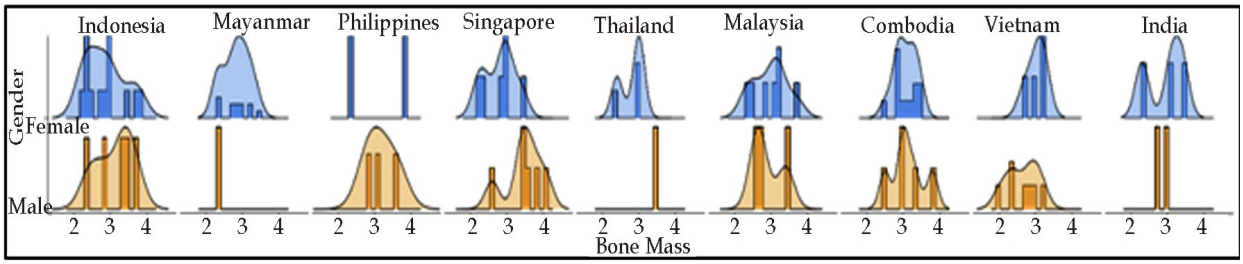

Fig. 2: Gender wise bone mass (kg) level observed in the 95 selected samples from nine countries

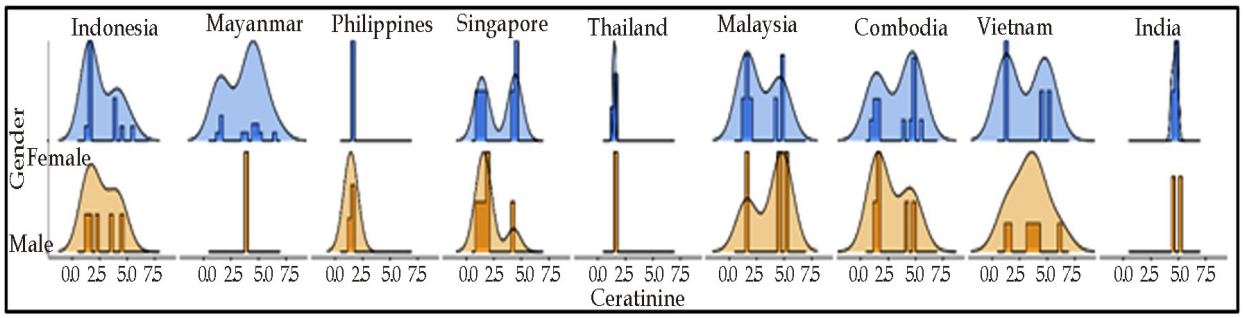

Fig. 3: Gender wise creatinine level observed in the 95 selected samples from nine countries.

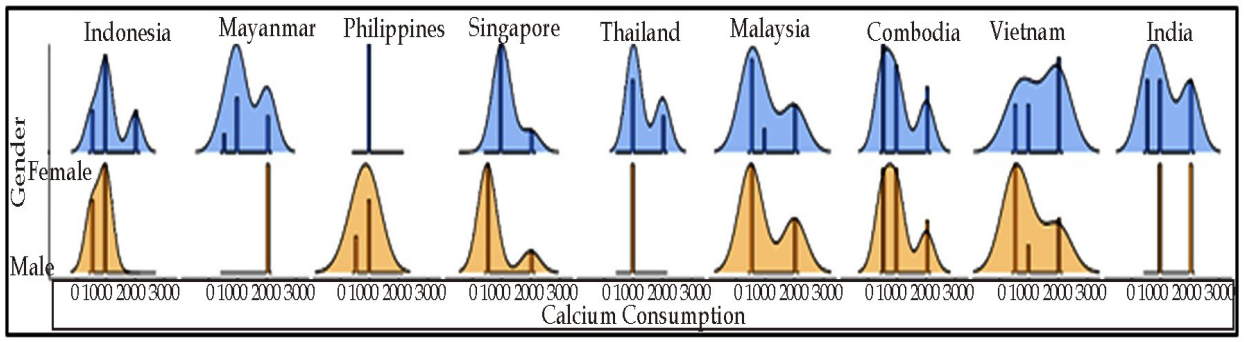

Fig. 4: Gender wise calcium consumption level observed in the 95 selected samples from nine countries

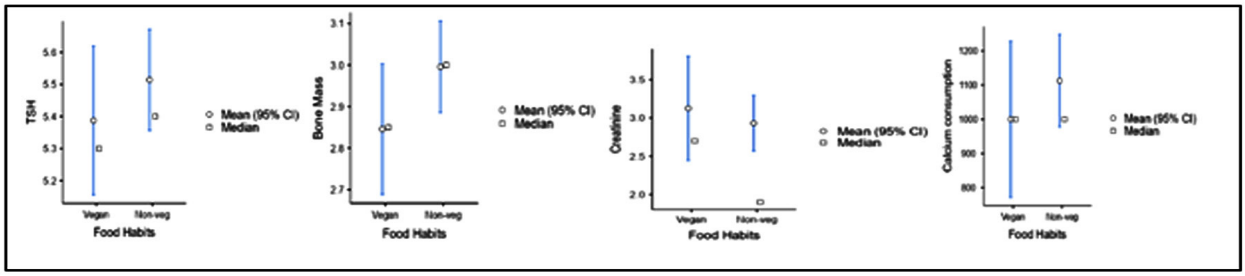

Fig. 5: Graphs of vegan vs. non-vegan habits irrespective of TSH, bone mass, creatinine, calciumconsumptions

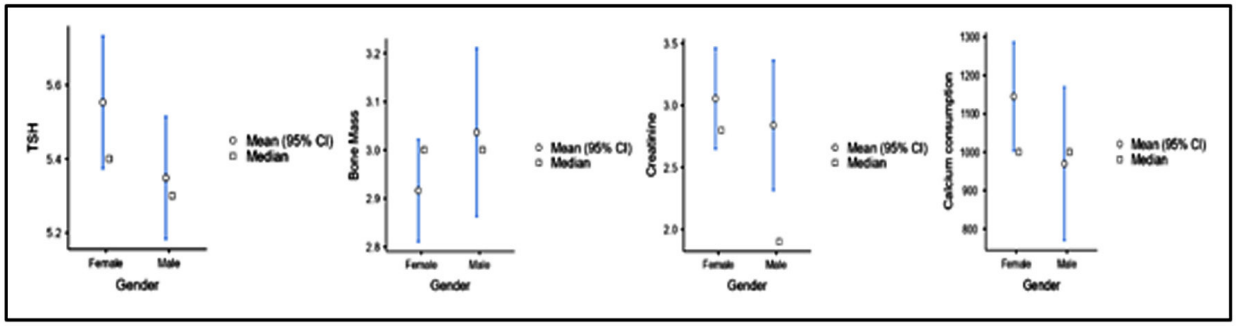

Fig. 6: Graphs of male vs. female samples irrespective of TSH, bone mass, creatinine, calcium consumptions.

Here are some graphs fig. 1-6 for pictorial presentations on the relations of significant groups and variables that are influencing the study.

CONCLUSION

Large numbers of Southeast Asian people are affected by hypothyroidism, chronic kidney disease, bone health, and other lifestyles disorders. Dietary habits and exercise practice are the major factors in such health issues. The study concludes that improper vegan or non-vegan diets can equally affect the health of male and female older adult populations. However, a proper diet can reduce the risks of diseases among SEA populations. More awareness and relevant researches are essential to understand the cause, effect and finally, the best possible solutions.

Source of Funding: Nil

Source of Conflict: Nil

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Review Article

International Journal of Food, Nutrition and Dietetics
Volume 10 Number 2, May – August 2022
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.10222.5

Musa Paradisiaca: Super Food With Splendid Benefits

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How to cite this article:
K Silambu Selvi, Shanthini Priya, J Sai Laavanya/ Musa Paradisiaca: Super Food With Splendid Benefits/Int J Food Nutr Diet. 2022;10(2):51–54.

Abstract

Musa paradisiaca (Banana blossom) is a nature's gift to mankind and is widely known for its huge nutritional and health benefits. It has potential to be regarded as a functional food or superfood due to its high nutrient content like fibre, protein, vitamin A, C, E, phosphorus, potassium, calcium, iron, magnesium. Banana flower has a high therapeutic value and it promotes lactation, reduces menustral bleeding, helps to control diabetes, anemia, reduce anxiety, ulcer, helpful in weight loss and good for gastrointestinal health. Inspite of being such a super food it is still undervalued in most part of the world, except in south-east Asian countries. Further research studies are required to record the health benefits of banana blossom.

Keywords: Banana blossom; Nutritents; Therapeutic value; Functional food.

INTRODUCTION

Banana plant (Musa species) is one of the world's leading fruit crops in developing countries, after staple cereals such as rice, wheat, and maize, with nearly 90% of the crops being grown for small-scale consumption and local trade.[1] FAO database stated that 103 million tonnes of bananaswere produced every year. Musa Paradisiaca [Banana blossom] is a highly nutritious edible flower and it is rich in nutrients and antioxidants with several health benefits. The whole banana flower constitutes several parts such as bract, bell, tepals, and stigma which has been studied for its health benefits. Banana flower bract is consumed by South East Asian countries and was found as the prime origin of anthocyanin and natural colorant.[2] In banana plantations the producers usually throw away the banana blossoms which are considered as agricultural by-products and it is getting more attention from many researchers and food manufacturers as a food source.[3]

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Received on: 11.02.2022
Accepted on: 15.03.2022

Biological Description of Banana blossom

Banana blossoms are finger-shaped which are extended under by large fleshy, reddish or purple coloured scales, which fall off as the fruit matures. The banana flowers are unisexual and it contains both male and female flowers. On the banana plant, first female flowers appear in which the ovaries develop into seedless fruit without being pollinated. The female flowers after it turns into fruits, their inflorescence extend the length and produces a cluster of male flowers within the brackets of the bud. When the male flowers die the bud slowly becomes smaller and only one inflorescence

develops per plant. From the underground rhizome the flowering stalk has been developed, that pushes up through the pseudostem of the plant and emerges at the apex. Finally, when the weight of the developing fruit increases, the flowering stalk curves downwards. During development, the elongated structure continues to elongate which results in older fruits being positioned downwards flowers and younger fruits being closer to the elongated tip.[4]

Nutritional Value of Banana blossom

Banana flowers, well known as banana hearts is a treasure trove of nutrients including fibre, potassium, calcium, copper, phosphorus, iron, magnesium and vitamin E for several body function. It could be incorporated into the regular diet in the form of salads, soups, stir-fries, vada and herbal concoctions.[5]

According to the African Journal of Biotechnology,100g of banana flower offers the below mentioned nutrition:

Nutrients	Quantity
Energy	51 Kcal
Protein	1.6 g
Fat	0.6 g
Carbohydrate	9.9 g
Fibre	5.7 g
Calcium	56 mg
Phosphorous	73.3 mg
Iron	56.4 mg
Copper	13 mg
Potassium	553.3 g
Magnesium	48.7 mg
Vitamin E	1.07 mg

FUNCTIONAL PROPERTIES OF BANANA BLOSSOM

Banana blossom has lot of health benefits. The few health benefits provided by banana blossoms is discussed below.

Rich in Antioxidants and Phytochemicals

Banana flowers are rich in phytochemicals like vitamins, flavonoids, and protein that will be used for the treatment of bronchitis, constipation and peptic ulcer.[6] Polyphenols are the secondary metabolites which has health benefits such as glucose homeostasis, obesity, type II diabetes, systemic inflammation or lipid metabolism and also used as a natural preservative.[7] Recent research reported that banana blossom extracts has been used for various industrial application of its high phenolic contents and flavonoids.[8] The banana blossoms also have important antibacterial and antioxidant properties.It has been shown that glucose transporters in Ehrlich ascites tumor cells was provoked by banana flower and pseudo stem extract.[9]

Helpful in Diabetes

It has been proved that the consumption of banana blossoms regularly for about a month helps to reduce the blood sugar level because of high fibre. Recent research showed that the whole edible parts of the banana flower especially the bract and bell are good source of anti-hyperglycemic potentials and fused tepals as pancreatic-lipase inhibitors.[10] Marikkar et.al., (2016)[11] indicated that banana blossoms also act as anenzyme inhibitor and is very usefulto treat diabetes.Ramith et. al., (2014)[12] reported that the ethanol extract of the banana flower contains high amounts of umbelliferone and lupeol, which could have an anti-hyperglycemic activity by inhibiting polyphenol pathway, protein glycosylation and α glucosidase. Jayamuthuganai and Elaveniya (2014),[13] stated that banana blossom contains 5.74g/100g rich dietary fiber which protects our body from lower blood cholesterol levels, obesity, normalizes blood glucose and insulin level.

Lowers Menstrual Bleeding

Banana blossoms has been used to treat the excessive blood loss during the menstrual cycle. It has the ability to regulate the progesterone level which helps to lower the muscle cramps that in turn reduce the painful bleeding. Apart from that it also contains magnesium that can reduce anxiety during that period. The banana blossoms is also believed to cure the polycystic ovarian syndrome.[5]

Increase the Milk Production in Lactating Mothers

Banana floweract as galactagogues vegetable which improves the breast milk secretion for the lactating mothers, support the uterus and reduces post-delivery bleeding. Therefore, it will be a blessing for new mothers who have problem in nursing their new-born baby.[4]

Good for Gastrointestinal Health

Banana blossom being a rich source of both soluble and insoluble dietary fibre, it provides a great help for people who is suffering from irritable bowel syndrome (IBS) and diarrhoea. The soluble fibre

dissolves in water and forms a gel, which allows food to pass easily through the digestive tract. But the insoluble fibres in blossom does not dissolve in water and helps to provide bulk of undigested waste products. Therefore, the individuals suffering from constipation are advised to increase their intake of banana blossoms. Both the types of dietary fibres [soluble and insoluble fibre] present in banana blossom helps for proper digestion and absorption of food in the gastrointestinal tract.[10]

Helpful in Ulcers

Banana blossoms are enriched with vitamin C and will be helpful in neutralizing the gastric juices and reduce ulcer irritation. Kumar et. al., (2012)[14] reported that the banana blossoms can be used to treat dysentery, ulcer and many more. It is believed that vitamin C plays an important role in promoting tissue repair and wound healing.

Helpful in Infection Treatment

Banana flower extracts are very useful for treating the infection in natural way. Jahan et.al., (2010)[15] studied antimicrobial activity of banana blossom extract in which certain bioactive compounds such as malic acid has shown antibacterial activity against Escherichia coli, Bacillus cereus and Bacillus subtilis. The juice of banana blossom was very useful in healing wounds particularly in children and it also prevents the malarial parasite, Plasmodium falciparum from growing and developing in the human body.

Keeps Mood Elevated and Reduces Anxiety

Banana blossom helps in improving the mood in every individual particularly in kids who have mood swings and are anxious by nature. It also act as remedy for mentally imbalanced kids who suffer from bouts of anxiety as it lowers the feelings of anxiety. The magnesium present in banana blossom act as anti-depressant which has anxiety reducing property.[4]

Helpful in Cardiovascular Disease and Cancer

Banana flower contains phenolic acids, tannins, flavonoids and various other antioxidants which neutralize free radicals, reduces the risk of heart diseases cancer and prevent oxidative damage. Banana flowers are a good source of flavonoids and in recent studies it has been proved that higher flavonoids (5.27 to 5.90 mg/100 g) exist in banana flowers than in banana peel. Flavonoids are very effective in controlling the risk of cardiovascular diseases byreducing the oxidation of LDL as well as preventing other degenerative diseases.[16]

Helpful in Weight Loss

As banana blossoms are rich in fibre, it provides a sated feeling for longer period, so it was very useful for kids and adults who are overweight or obese. Incorporating the banana blossom in one's meal in the form of soup, salad, curry or any other form, will help in weight loss.[14]

Reduces Anemia

Banana blossoms are rich in iron, that improves thesymptoms associated with anemia such as fatigue, tiredness, irregular heartbeat, pale skin, cold feet and hands. Regular addition of banana flower in the meal increases the levels of red blood cells and combats iron deficiency anemia.[4]

CONCLUSION

Banana blossoms represents as a superfood, especially for women to keep their uterus healthy, lowers Menstrual bleeding, act as lactating agent, reduce anxiety and improves mood. It can be reviewed as a foodloaded with lots of nutrients like high dietary fibre, good quality protein, potassium, calcium, copper, phosphorus, iron, magnesium, vitamin E, A and C along with various antioxidants and total flavonoid concentrations.The therapeutic power packed banana flower can be used in various cuisines all over the world.

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Review Article

International Journal of Food, Nutrition and Dietetics
Volume 10 Number 2, May – August 2022
DOI: http://dx.doi.org/10.21088/ijfnd.2322.0775.10222.6

Impact of Heat on Naturally Present Digestive Enzymes in Food

Indresh Kumar[1], Priya Yadav[2], Madhulika Gautam[3], Hema Panwar[4]

How to cite this article:
Indresh Kumar, Priya Yadav, Madhulika Gautam, et al./Impact of Heat on Naturally Present Digestive Enzymes in Food/ Int J Food Nutr Diet. 2022;10(2):57–63.

Abstract

Enzymes are dissolution large complex molecules like proteins, carbohydrates, and fats into smaller ones. They are secreted by the salivary glands and gastric mucosa of the stomach, pancreas, and small intestine, also present in many fruits and vegetables in significant amounts. The objective of this study was to review the available literature on the naturally available enzyme on food like fruits and vegetables and the impact of heat on their activity. Foods that contain natural digestive enzymes include pineapples, papayas, mangoes, bananas, avocados, kiwifruit, and ginger indicating that enzyme disintegration is influenced by temperature. The optimum temperature for protease activity of kiwifruit, papaya, zinger, and pineapple was at 40 degrees Celsius (°C) and active between 8 to 70°C. Amylase of banana, mango has been testified to activity between 8°C and 38°C and the optimum temperature was 30, starting to be denatured at 38°C and being fully denaturized after 5 minutes at 100°C. The Avocados lipase was active in the temperature ranging from 5 to 65°C and the optimum temperature for lipase action was observed to be 37°C.

Keywords: Digestive enzymes; Natural enzymes; Food enzymes; Digestion; Optimum temperature.

INTRODUCTION

Digestive enzyme activity is intricate in the regulation of growth performance because digestive enzymes act by absorption to improve feed efficiency and in turn modify the process of nutrient metabolism.[1] Digestive enzyme are essential for this process, as they break down molecules like fats, proteins, and carbs into even smaller molecules that can be easily absorbed.[2] There are three main types of digestive enzymes: **(*I*) *Proteases:*** Break down protein into small peptides and amino acids **(*II*) *Amylases*:** Break down carbohydrate like starch into simple sugars **(*III*) *Lipases:*** Break down fat into three fatty acids plus a glycerol molecule. Enzymes are also made in the small intestine, including lactase, maltase, and sucrase.[3,4] If the body is unable to make enough digestive enzymes, food fragments cannot be digested properly.[5] This can lead to digestive illnesses like lactose intolerance. Thus, eating foods that are rich in natural digestive enzymes can help improve digestion.[6] The objective of this study was to review the available literature on the naturally available enzyme on fruits and vegetables. The study of the field shows that digestive enzymes can be obtained naturally through foods. A well-balanced diet that contains fresh fruits and vegetables, lean proteins, and whole grains.[7] These foods will certainly help support the work digestive enzymes are already doing. Adding any of these

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Received on: 02.02.2022
Accepted on: 05.03.2022

foods to the diet may help promote digestion and better gut health. Enzyme activity can be influenced by a variety of aspects, such as temperature, the potential of hydrogen (pH), and concentration.[8] Enzymes work best within specific temperature and pH ranges, and sub-optimal circumstances can cause an enzyme to be unable to find its capability to bind to a substrate. These enzymes found in fruits and vegetables are also affected by temperature,[9] so it becomes necessary to assess the effect as well as optimum temperature for activity.

METHOD

A consolidative review of the literature was carried out before January 2022. Applicable articles were identified by applying search strategies to six academic electronic databases: PubMed, Scopus, SpringerLink, Article First, Wiley Online, and Science-Direct. Search terms and keywords included: Proteases, Lipases, Amylases, Digestive enzymes, the enzyme in fruits and vegetables. All retrieved titles, abstracts, and full-text publications were studied and screened for importance to the topic. Furthermore, references from retrieved articles were reviewed to identify additional applicable publications. In this research, the paper study was included within 10 years of the publication on the relevant field.

RESULTS

Digestive enzymes are proteins that break down larger fragments like fats, proteins, and carbs into smaller particles that are easier to absorb across the small intestine.[10] Without enough digestive enzymes, the body is incapable to digest food particles properly, which may lead to food intolerances.[11] Significant fruits, such as pineapples, mango, papaya, ginger, kiwifruits, and oranges contain natural digestive enzymes that determine their quality.

(I) ***Proteases:*** Protease enzyme catalyzes proteolysis, breaking down proteins into smaller polypeptides or basic unity of amino acids, and encouraging the formation of novel protein products.[12] They do this by smiting the peptide bonds within proteins throughout hydrolysis, the reaction where the water breaks bonds. Fruits like papaya, kiwifruit, pineapple, and figs all contain enzymes named proteases. Proteases speed up the dissolution of proteins.[12] Kiwifruit showed the highest protease activity appeared in the temperature range of 50–60 degrees Celsius (°C), depending on the fruit extract.[13] The optimum activity of crude protease extract was found at pH 7.0 and 50°C.[14] The crude protease enzyme was highly stable stability at temperatures below 40°C. When based on the overall reviewed data, the enzyme's activity of fruit protease showed activity at a temperature of 40°C to 70°C and the optimum temperature was 50°C.

Kiwifruit: The kiwifruit is an edible berry that is often suggested to ease digestion.[15] It's a great source of digestive enzymes, particularly a protease called actinidin. This enzyme supports digest proteins and is commercially used to tenderize tough meats. Moreover, kiwifruit contains many other enzymes that support ripening the fruit.[16] Researchers believe actinidin is one reason why kiwifruits seem to relieve digestion. An animal study found that adding kiwifruit to the diet enhanced the digestion of beef, gluten, and soy protein divorces in the stomach.[12] This was thought to be due to its actinidincontent.[16] Another animal study analyzed the effects of actinidin on digestion.[14] It fed some animals kiwifruit with active actinidin and other animals kiwifruit without active actinidin. Results exposed that animal-fed kiwifruit with active actinidin digested meat more proficiently. The meat also stimulated faster through the stomach.[17] Numerous human-based studies have also found that kiwifruit aids digestion, decreases bloating, and helps relieve constipation.[18]

In the case of proteolytic enzymes in kiwifruit, the maximum value of protease activity was observed at 50°C and sustained its activity up to 70°C.[19] The optimal temperature for the enzyme (actinidin) activity extracted from kiwifruit has been testified to be approximately 58°C to 62°C, and bromelain, which belongs to the cysteine plant proteinases that are known to attack myofibrillar proteins, has an optimum temperature range of 60°C to 70°C.[20]

Ginger: Ginger has been a portion of cooking and traditional medicine for thousands of years.[21] Some of ginger's impressive health benefits may be attributed to its digestive enzymes. Ginger covers the protease zingibain, which digests proteins into their building blocks.[22] Zingibain is used commercially to make ginger milk curd, a popular Chinese sweet course. Unlike other proteases, it's not often used to tenderize meats, as it has a rapid shelf life.[23] Food sitting in the stomach for too long is often thought to be the cause of indigestion. Studies in healthy adults and those with indigestion illustrate that ginger aided food move faster through the stomach by encouraging contractions.[24] Studies on animalshave shown that spices, including ginger, helped increase the

body's creation of digestive enzymes like amylases and lipases. What's more, ginger appears to be anauspicious treatment for nausea and vomiting.[25]

The protease displayed optimum activity at 60°C and pH 6 to 8, respectively.[20] The result obtained is similar to the findings of those who reported that ginger protease exhibited broad optimal proteolytic activity from 40 to 60°C and lost its activity when the temperature increased to 70°C.[26] According to another researchzingibain exhibits a maximum turnover rate at 60°C and rapidly denatures at 70°C. Proteolysis is largely unhampered during cooking with ginger.[27] Optimal temperature ranges of papain and ficin are elevated relative to zingibain, whereas bromelain operates at a somewhat lower range.[8]

Pineapple: Pineapples are a wonderful tropical fruit rich in digestive enzymes.[2] In particular, pineapples comprehend a group of digestive enzymes called bromelain.[4] These enzymes are proteases, which break down protein into its building blocks, including amino acids. This aids the digestion and absorption of proteins.[5] Bromelain can be obtained in powdered form to help tenderize tough meats.[28] It's also generally available as a health supplement to support people who struggle to digest proteins.[29] A study on people with pancreatic insufficiency, a condition in which the pancreas cannot make enough digestive enzymes initiate that taking bromelain combined with a pancreatic enzyme supplement enhanced digestion additional than the enzyme supplement alone.[30] According to a study on the enzymatic activity of bromelain decreased gradually from 25°C to 95°C. Complexed bromelain was unchanging inactivity to heating up to 85°C.[31]Bromelain polyphenol complex showed a good heat resistance.[30] The result exposed that polyphenol could protect bromelain in pineapple juice from heat denaturation.[28] Bromelain from pineapple stems is completely inactivated by heating for 30 min at 60°C; initiate that bromelain retained 50% of its activity level after 20 min heating at 60°C.[30]

Papaya: Papaya is a tropical fruit rich in digestive enzymes proteases that help digestion of proteins.[4] However, they contain a diverse group of proteases recognized as papain. Papain is also available as a meat tenderizer and digestive supplement.[32] Studies have exposed that taking a papaya-based method may help ease digestive symptoms of irritable bowel syndrome, such as constipation and inflating.[33]

Heat exposure can destroy their digestive enzymes also,[32] unripe or semi-ripe papayas can be unsafe for pregnant women, as they may stimulate contractions.[34] Papain has an best temperature of 65°C and denatures at around -13°C and 85°C (Papain).[35] However, if the temperature of papain goes beyond 65°C, then the rate of reaction will reduce as the temperature increases.[36]

Fig: Fig has a digestive enzyme existing called ficin, classified as a thiol protease.[3] It helps in nourishing the digestive tract which returns helps in digesting food rapidly. An important key to losing weight as well as tumblingabdomen fat by keeping a healthy digestive system. It comprehends a reactive cysteine in its dynamic part. There was no significant difference in ficin activity at the incubation temperatures of 40°C and 50°C, as well as 60 °C and 70°C.[37] Nevertheless, comparisonof the incubation temperatures of 40°C and 50°C with treatment 60°C and 70°C exposed a significant difference in ficin enzyme action.[38]

(*II*) *Amylase*: Theycover the digestive enzymes amylases are a group of enzymes that break down carbohydrates from starch (a complex carbohydrate) into glucose and maltose.[1,6] Amylase enzymes are correspondingly made by the pancreas and salivary glands.[3] They help break down carbohydrates so that they are simply absorbed by the body.[1] That's why it's often suggested to chew food carefully before swallowing, as amylase enzymes in saliva help break down carbohydrates for relaxed digestion and absorption. For instance, Pineapples naturally contain liquid acid amylase and amyl-glucosidase as an enzyme, which renovates starch to sugar maltose whereas proteases convert proteins into amino acids.[9]

***Mango*:** Mangoes contain the digestive enzyme amylase, which breaks down carbohydrates from starch (complex carbohydrates) into sugars like glucose and maltose.[6] Amylase also helps mangoes ripen. Amylase enzymes are too made by the pancreas and salivary glands. They support breaking down carbohydrates so that they are effortlessly absorbed by the body.[8] That's why it's often suggested to chew food thoroughly before swallowing, as amylase enzymes in saliva help break down carbohydrates for easier digestion and absorption.

Heat Sensitive Enzyme(HSE) was first screened in fresh mango flesh of the variability Samar Bahisht, Chaunsa.[38] Later, the combined effect of different drying temperatures (40 °C, 50 °C, 60 °C, 70 °C, and 80 °C) on the active retention of HSE in dried mango slices of the varieties Sindri, Samar Bahisht, Chaunsa, and Tommy Atkins was investigated.[39] Drying at higher temperatures with a high air

velocity caused a severe reduction of enzyme activity. Some study recommends anappropriate temperature and air velocity to reduce enzyme destruction in dried mango products.[18]

Results of some studies showed that the extreme amylase and invertase activity for dried mango of all three varieties was best preserved in samples dried at a temperature of 80°C.[38] In addition, the correlation of enzyme activity with changes in heat-sensitive nutrients of mango during convective drying and the influence of maturity on enzyme activity needs to be investigated and the optimum temperature for amylase activity was 50-60 °C.[39]

Banana: Bananas fruit have encompassed natural digestive enzymesamylases and glucosidases, two groups of enzymes that break down complex carbohydrates like starch into smaller and more effortlessly absorbed sugars.[9] Due to enzymes breaking down starch into sucrose as bananas start to ripen, ripe yellow bananas are much sweeter than unripe green bananas.[16] Two-month research in 34 women looked at the connection between eating bananas and the growth of healthy gut bacteria. Women who ate two bananas every daypracticed a modest, non-significant rise in healthy gut bacteria. Nevertheless, they did experience significantly less bloating.[29]

The amylase research, which was very stable at 4°C, hydrolyzed soluble potato starch and banana starch at similar rates.[40] Maximum activity was observed between pH 6-7. Amylase was fairly active up to 62°C but fast lost activity above this temperature. There was an approximately twofold upsurge in amylase through the initial phase of ripening. Exactly, α-amylase isolated from banana pulp has been testified to present an optimum activity between 8°C and 38°C, starting to be denaturized at 38°C and being fully denatured after 5 minutes at 100°C.

(*III*) *Lipase:* [3]Lipase is a type of protein made by the pancreas, that assistances the body digest fats. Lipase is an enzyme that catalyzes the hydrolysis of fats and[5] subclass of the esterases. Lipases perform important roles in the digestion, transport, and processing of nutritional lipids in most, if not all, alive organisms.

Avocados: Contrasting other fruits, avocados are exceptional in that they are rich in healthy fats and digestive enzyme lipase.[36] This enzyme helps digest fat molecules into smaller molecules, such as fatty acids and glycerol, which are easier for the body to absorb.[12] However, taking lipase avocados can help comfort digestion, especially afterward a high-fat meal.Avocados also contain other enzymes, including polyphenol oxidase.[40] This enzyme is accountable for turning green avocados brown in the attendance of oxygen. Studies have shown the enzyme extract from avocados had an optimum lipase activity temperature of 36 °C and pH 6.[41]

Orange: The occurrence of lipases was experiential in three byproducts of orange juice processing: peel, core, and frit.[15] It is not directly present in the pulp, it has to be separated from the peel, which requires processing.[42] The orange lipase comes out as a byproduct of orange and the optimal temperature for the action of these byproducts showed a wide range at 20 °C to 70 °C, representative fairly high thermostability.[43]

CONCLUSION

Pineapples contain a group of digestive enzymes called bromelain; papayas contain the digestive enzyme papain booth helps in the breakdown of proteins into amino acids. Mangoes and bananas contain amylase and bananas contain amylases and glucosidases which break down complex carbohydrates into simple carbohydrates like glucose and maltose. They are more active as bananas and mangoes start to ripen. Avocados contain the digestive enzyme lipase, which breaks down fat molecules into smaller fatty acids and glycerol. Kiwifruit contains the digestive enzyme actinidin, which helps digest proteins. Gingerincreases the body's production of digestive enzymes like amylases and lipases. Literature shows that high heat can destroy digestive enzymes and most digestive enzymes show optimum temperature from 30 to 50. Protease of kiwifruit, papaya, zinger, and pineapple activity temperature was 40°C to 70°Cand the optimum temperature was 50°C. Avocados lipase was active in the temperature ranging from 5 to 65°C and the optimum temperature for lipase action was observed to be 37°C. Amylase isolated from banana pulp has been testified to present an optimal activity between 8°C and 38°C, starting to be denatured at 38°C and being fully denaturized after 5 minutes at 100°C and the optimal temperature for amylase action was 50-60 °C.

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