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## **Practices and Importance of Dietary Antioxidant Rich Foods in Nepal**

Kabita Maharjan\*, Ph.D. Scholar  
kdkabs@gmail.com

\*Nepal Cancer Hospital and Research Center

### **Abstract**

**Introduction:** The role of antioxidant-rich nutritious foods like fruits and vegetables in preventing non-communicable diseases is critical. It helps to neutralize oxidative and nitrosative stresses. The nitrosative stresses are harmful to health and antioxidant-enhancing control of such stresses.

**Objective:** The study aims to explore the benefit of dietary antioxidants such as fruits and vegetables that helps to reduce oxidative and nitrosative stress levels. A high level of oxidative and nitrosative stress levels results in non-communicable disease and depression.

**Methods:** Both primary and secondary data are used for the study. Literature related to antioxidant foods is intensively reviewed. Primary data are collected through structured questionnaires with 68 numbers of respondents in Lalitpur metropolitan city, ward 28 in order to know the usage and knowledge of antioxidant practices at the ground level. There were 68 respondents with 88% of females and 12% of males between 20 and 60 years of age. The food frequency questionnaire was used to collect data.

**Findings & Discussion:** Nepal is rich in antioxidant foods, however, only a small population has access to it. Likewise, many people are unaware of its proper consumption or usage. The consumption of fruits in Nepal is poor; only 2.7 and 1.6 in urban and rural respectively weekly based which is poor and below than average. From the food frequency table of primary data, it is shown that the consumption of fruits once a day is only by 9 among 68 respondents which is poor and below average. The finding suggests that dietary antioxidant source fruit intake is used by small numbers and chances of non-communicable diseases may be high.

**Conclusions:** There has been a practice of dietary antioxidants, though on a small scale and a majority of them were unconscious of the proper use of dietary antioxidants.

**Keywords:** Consciousness, dietary antioxidant, immune system, non-communicable disease

## **Introduction**

Antioxidants can be understood as compounds produced in human bodies and found in foods like fruits and vegetables particularly; it help to defend our cells from damage. It is a micronutrient chemical component that helps in regulating bio functions neutralizing free radicals produced from oxidation (NCI, 2017) which helps to stop the spreading of non-communicable diseases. There are two sources of antioxidants- exogenous and endogenous. Exogenous antioxidant gets from food, whereas endogenous within the body. The dietary antioxidants in foodstuffs are related to vitamins A, C, E, and Selenium. The major source of antioxidants belongs to plant source foods like fruits. The antioxidant helps to contribute electrons to the free radical and becomes stable and less reactive it supports not damaging cells and prevention of non-communicable health problems or diseases like cancer, neurodegenerative diseases, rheumatoid arthritis, and depression.

According to American Cancer Institute (ACI, 2015), it relates to chemical compounds which protect against disease are called phytochemicals. It acts as an antioxidant and fragile the free radicals to create cell damage (ACI, 2015). According to Nindiya (2007) phytochemicals work in cancer by modifying the hormonal effect and it helps to neutralize free radicals in the body. Therefore the importance of antioxidants is obvious.

The best sources of dietary antioxidants are fruits and vegetables. Several studies on dietary supplements like vitamin C, vitamin E, and beta-carotene are supposed to suppress oxidative stress-produced free radicals. Dietary supplements such as vitamin C, vitamin E, and beta-carotene (antioxidant) are extensively recommended to be used for their hypothesized role in averting oxidative stress caused by oxygen free radicals (Davì et al., 2005; Hitchon and El-Gabalawy, 2004; Nunomura et al., 2006; Tamimi et al., 2005). The endogenous factors come from where free radicals can be formed. Some externally generated sources of free radicals as cigarette smoke, pollution, ultraviolet rays, industrial solvents, and so on.

The American Heart Association suggests a diet high in fruits and vegetables that contain antioxidants to help fight cardiovascular disease. According to Nindya (2007), scientists' experiments on dietary antioxidants found that people who consumed dietary antioxidants have a vital role in

preventing chronic diseases like cancer. Similarly, Hajhashemi (2010), states that an antioxidant supplement provides benefits to human health, but is still confused about how it works on disease prevention and mortality. The study carried out by Borek (2004), states that selenium activates the antioxidant enzyme glutathione peroxidase in normal cells. Likewise, vitamin E protects the regular mechanism of acetylcholine receptors in good-function neuron cells and prevents toxicity and oxidative stress apoptosis increased in the brain. Similarly, vitamin E and vitamin C help to reduce pain in cancer patients under radiation therapy-induced fibrosis (Borek, 2004). The additional supplement not only benefits but toxicity too. According to Standford Medicine (2020), a past study showed that antioxidant supplement was advised to prevent cardiac diseases. Several clinical trials with high doses of antioxidant supplements showed questionable results (Standford Medicine, 2020). It is nature's rule that everything has to be balanced for survival existence. Likewise, according to Sriinstitute (2014), excessive antioxidants may be a failure in balancing free radicals because artificial antioxidants are not easily absorbed and may have remaining particles which support building side effects (Sriinstitute, 2014). McNaughton (2005), reviewed in UK 2000-2001 National Diet and Nutrition Survey showed that the supplement intake among age between 50-64 years women is 55% whereas 34 % in men respectively.

Nepal is rich in antioxidant foods (referring to table 1) like fruits and wild edibles; it contains both macro and micro essential dietary nutrients which are beneficial to human health. However, only a small population has access to it. Literature suggests that many people are unaware of its proper consumption or usage. Likewise, the practice of fruits as regular food items has not become common in Nepali society. According to FAO, the nutritional status of mothers and children under the age of 5 is extremely poor. Under nutrition in Nepal remains a significant issue, and overweight and obesity are also becoming health concerns (USAID, 2021). The intake of antioxidant-rich food is essential but one needs to be aware while using it.

### **Data collection and Methods**

The study is based on primary and secondary data. The papers, articles, and related books were intensively reviewed. For primary data, 68 persons

were interviewed, out of which, there were 88 % belonged to females and 12 % possessed males. The sample population was taken from Lalitpur metropolitan city, ward 28 of Lalitpur district, Bagmati province. The food frequency questionnaire was used to collect data. The data collection was carried out from May 5<sup>th</sup> to 24<sup>th</sup> 2021.

**Table 1: Sample size (n=68)**

S.No	Gender	Number	Percentage (%)
1	Male	8	12
2	Female	60	88
	<b>Total</b>	<b>68</b>	<b>100</b>

The structured questionnaire was used to collect data. Descriptive statistics are used as a research design. The study attempts to assess and explore the practices and perception advantages of antioxidants.

### **Availability of Dietary Antioxidant-Rich Fruits and Vegetables in Nepal**

The antioxidant-related fruits and vegetables are locally available in Nepal. Apple, orange, watermelon, strawberries, and gooseberry are major fruits. Similarly, cauliflower, cabbage, broccoli, tomato, onion, etc. are major vegetables consumed in Nepal. The rich antioxidant fruits and vegetables available in Nepal are given in the table-1 below with their benefits.

**Table 2: Major Antioxidant-Rich Fruits and Vegetables in Nepal**

Antioxidant-Rich Food	Scientific Name	Benefits
<b>Vegetables</b>		
Cauliflower	<i>Brassica oleracea</i>	Improve the immune system and may inhibit cancer cells growth
Broccoli	<i>Brassica oleracea</i>	Hold tumor growth, helps to detoxify carcinogenic substances

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Cabbage	<i>Brassica oleracea</i>	Hold tumor growth, helps to detoxify carcinogenic substances
Tomato	<i>Solanum Lycopersicum</i>	Improve the immune system and may inhibit cancer cells growth
Garlic	<i>Allium sativum</i>	
Onion	<i>Allium cepa</i>	Aid immunity power, Produce detoxifying enzymes and may inhibit inflammation
<b>Fruits</b>		
Apple	<i>Malus</i>	Aid immunity power, Produce detoxifying enzymes and may inhibit inflammation
Orange	<i>Citrus X sinensis</i>	Improve the immune system and may inhibit cancer cells growth
Watermelon	<i>Citrullus lanatus</i>	Improve the immune system and may inhibit cancer cells growth
Strawberries	<i>Fragaria ananassa</i>	reduce LDL cholesterol
Gooseberry	<i>Phyllanthus emblica</i>	Vitamin c

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## Trends and practice of Dietary Antioxidant

### Global Trends

According to Transparency Market Research (2018), the consumption of antioxidant food additives is higher in developed countries are finding higher than in others. As for Allied Market Research (2016), the Global Antioxidant Market was valued at \$2,923 million in 2015 and the number was expected to rise by \$4,531 million by 2022 which can be expressed in Compound Annual Growth Rate (CAGR) of 6.73%. The utilization of food antioxidants in the world is growing at a CAGR of 6.0% during the forecast period (2019-2024); its demand and consumption of processed food, where food antioxidants are highly used is increasing

([www.mordorintelligence.com](http://www.mordorintelligence.com)). It has been used in bakery, confectionery, and snack products as well.

## Nepal

In Nepal, the practices of dietary Antioxidants have been found both for clinical and household purposes. Nepal has been facing nutritional deficiency problems such as vitamin A & C deficiency. Vitamin A deficiency disease is related to an eye problem. Likewise, vitamin C deficiency causes scurvy, which is directly related to the immune system. Generally, the 50+ aged population needs multiple micro-nutrients, and supplements such as vitamins and oxidants, which is a clinical need to enhance the quality of life. To overcome malnutrition, the role of antioxidants is critical. Clinically, health experts used to prescribe antioxidant supplements.

The consumption of fruits in Nepal is not satisfactory and varies from urban to rural. Fruits are the major source of antioxidants in Nepal.

**Table 3: Antioxidant Food Consumption in Nepal**

Areas	Fruits	Vegetables
Urban	2.7	6.8
Rural	1.6	6.7

Source: NPC, 2018

Table 3 shows the antioxidant fruit and vegetable consumption patterns, weekly based on rural and urban areas. The consumption of fruits is poor. Only 2.7 and 1.6 fruit consumption in a week is found in urban and rural respectively. This consumption pattern is found poor and below average. Nepal faces an acute of using fruits that contain a richness of antioxidants. However, vegetables are regularly used as regular food. Without vegetables, a Nepali meal is incomplete.

### Antioxidant Food among respondent

Table 4 shows the respondent’s fruit frequency consumption pattern. A large number of respondents prefer oranges to other fruits daily basis. Orange is also rich in vitamin c, and fiber and helps. The respondent’s preference towards apples is found poor. Apple is considered a king of fruits. Grapes are consumed only once a week, which is a lower consumption pattern; the price of grapes is higher may be the reason behind it. Usually, green and black grapes are common in Nepal. Black grapes are quite expensive and sweeter than green ones.

**Table 4: Fruits Frequency**

Fruits	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day	Total
Apple	9	21	12	22	2	2	0	0	0	68
Grapes	5	24	21	14	1	3	0	0	0	68
Orange	13	30	15	5	1	4	0	0	0	68
Watermelon	28	27	9	2	2	0	0	0	0	68
Papaya	35	24	4	5	0	0	0	0	0	68
Total	90	126	61	48	6	9	0	0	0	

Source: Field Survey, 2021

Among the respondent, 75% of respondents complained that fruits such as apples, organs, grapes, pomegranates, and guava were so expensive. However, almost all respondents preferred these fruits. The literature suggests that fruits are loaded with healthful micronutrients and are needed for the daily diet. Besides these expensive fruits, there are various types of fruits that have a richness of antioxidants but are cheap like *Amala*. An *Amala* named “Indian Goose Berry” is rich in vitamin C. One ‘Amala’ is supposed to have equal to 3 oranges in terms of vitamin C. However, only a few would know about it, and hence nutritional awareness is needed.

### Vegetable frequency

Vegetables such as cauliflower, broccoli, cabbage, tomato, garlic, onion, carrot, and green leafy are rich in terms of antioxidants which are used by the majority of Nepali. Green leafy vegetables are rich in carotenoid antioxidants as well as rich in fiber, iron, magnesium, and calcium (Lin, 2016).

**Table 5: Vegetable frequency consumption**

S.No.	Vegetables	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day	Total
1	Cauliflower	7	6	17	36	1		1			68
2	Broccoli	25	17	17	6	2	1	0	0	0	68
3	Cabbage	17	12	17	15	4	3	0	0	0	68
4	Tomato	0	0	0	3	0	8	52	5	0	68
5	Garlic	0	0	1	2	1	8	53	3	0	68
6	Onion	1	1	0	3	3	4	53	3	0	68
7	Carrot	5	15	5	24	9	6	4	0	0	68
8	Green Leafy	0	3	9	47	3	3	3	0	0	68
Total		55	54	66	136	23	33	166	11	0	

Source: Field Survey, 2021

Table 4 shows that the intake of tomato, garlic & onion has been consumed in a higher number, which represents 31% amount of consumption by 2-3 times a day. The tomatoes are rich in carotenoid and lycopene. A carotenoid is a pigment that is an antioxidant and boosts the immune system. Likewise, lycopene prevents chronic non-communicable diseases. According to Godman (2012), carotenoids help to eliminate free radicals which prevent the DNA structure. Therefore, it helps to prevent stroke as well as some cancer. Similarly, garlic contains chemical components which are known as anti-tumor, anti-microbial, anti-protozoal, anti-fungal, and anti-viral; it prevents cardiovascular disease (Jang, 2018). In Nepali cuisine tomato, garlic and onion have highly been used as a spice and mixed in most recipes.

In Nepalese cuisine, these vegetables are mostly mixed with other vegetables. Raw garlic is used for medicinal purposes. Garlic is rich in an

antioxidant named “Allicin”. The consumption of garlic is high as it is used in the form of spices. Among these mentioned vegetables the consumption of green leafy vegetables is found a higher.

The various types of green leafy available in Nepal have many benefits. In 5-6 per week, the consumption of carrots seems to be higher, the carrot is the best source of beta-carotene. At once a week, the intake of cauliflower, broccoli, and cabbage was found which belongs to 25% only.

### Knowledge towards an antioxidant and balanced diet

A balanced diet means the proper combination of fruits, vegetables, and other foods. In the absence of fruits or vegetables, a balanced diet cannot be completed, and hence the role of antioxidants is vital. Table 6 shows that 79.4% of the respondent acknowledged balanced nutrition. Amongst, ages between 31 and 40 were more about nutritional knowledge. It can be said that people are conscious of health to some extent. Nevertheless, the practice of a balanced diet in daily life is found poor.

**Table 6: Respondent’s Knowledge of Balance Diet**

Nutritional Knowledge		Age					Total
		<20	21-30	31-40	40-50	>50	
No	Count	4	6	2	1	1	14
	% of Total	5.9%	8.8%	2.9%	1.5%	1.5%	20.6%
Yes	Count	9	17	22	4	2	54
	% of Total	13.2%	25.0%	32.4%	5.9%	2.9%	79.4%
Count		13	23	24	5	3	68
% of Total		19.1%	33.8%	35.3%	7.4%	4.4%	100.0%

Source: Field Survey, 2021

### BMI, Antioxidant and Health status

BMI (Body Mass Index) represents an estimate of body fat. A higher BMI value means a higher risk of certain diseases such as heart disease, high blood pressure, type 2 diabetes, and certain cancers. The role of antioxidant foods enhances in reducing fats and disease risks. It helps to reduce the

negative effects of obesity and oxidative stress on the physiological systems of the body. Antioxidants may modulate dynamic cellular targets and processes to improve the redox imbalance in obesity. In overall, 79.4% of respondents acknowledged about nutrition diet. However, the normal BMI-related respondents were found 32.4% while 8.8% do not know. Statistically, there is significant difference between BMI status and nutritional knowledge (Table 6), but poor association.

**Table 6: BMI status by age and nutritional knowledge**

Nutritional Knowledge		BMI cutOff line					Total	
		<18.5	18.5-22.9	23-24.9	25-29.9	>30		
No	Count	3	6	2	3	0	14	
	% of Total	4.40%	8.80%	2.90%	4.40%	0.00%	20.60%	
Yes	Count	2	22	7	18	5	54	
	% of Total	2.90%	32.40%	10.30%	26.50%	7.40%	79.40%	
		Count	5	28	9	21	5	68
		% of Total	7.40%	41.20%	13.20%	30.90%	7.40%	100.00%

Source: Field Survey, 2021 *Calculated Pearson correlation coefficient (R) is 0.241*

Note: BMI cut off point is follows:

BMI Cut off point	Nutritional Status
<18.5	Underweight
18.5-22.9	Normal
23-24.9	overweight
25-29.9	Pre-obese
> 30	Obese

Table 6 shows the nutritional status of the respondents; 52% of the respondent has a higher BMI value which is a risk sign of non-communicable diseases. Whereas 40% have normal and 7% have lower BMI reference values. Both the lower and higher BMI value is a health risk

signs of under and over-nutrition. Under-nutrition shows the imbalance between energy input and expenditure. The female belongs to the vulnerable group in terms of childbearing. The female prioritized health so that newly born babies might not get health issues, and the healthy population reduced the health budget. The literature on the vicious cycle proved that malnourished mothers always give birth to malnourished children. 19 % of the respondent accounts for co-morbidity, among them, 6% have Type 2 diabetes, Hypertension, Thyroid, and Uric acid. 80% of the respondent were aware of basic nutrition knowledge, whereas 20 % were unaware respectively. All the respondents of the study belong to a productive age of above 16 and below 65 years. The respondent up to 20 years was 19%, 21 to 30 years, 34%, 31 to 40 years 35%, 41 to 50 years 7%, and 51 to 60 years 4% respectively. It implies that awareness of health and nutrition is needed.

### **Discussion and Implication**

Based on the above data, fruit consumption is significantly found less than vegetables. Out of 68 respondents, only 13% of respondents used to take fruits once a day only. Fruits intake quantity in a day seems to be very lower. While major fruits are easily available in the Nepali market, especially in urban areas. According to the WHO, the intake of fruits and vegetables should be at least 400 grams per day. While consumption of fruits amount is very lower. Less intake of fruit consumption is a challenging issue in light of healthy life. According to NPC (2018), fruit consumption in an urban area is found 2.7. Whereas it is 1.6 days in a week in rural areas. However, all fruit production comes from rural areas, though there is a lower quantity of fruits despite the 2-3 times usage per day. The majority of respondents do not use fruits during the day despite their availability. It indicates that there is a lack of awareness regarding a balanced diet.

In comparison to fruit, vegetable consumption is high as it stands for 2-3 times per day which shows a higher standard. The consumption of tomatoes, garlic, and onion is high. According to the CDC (Centers for Disease Control and Prevention), vegetable intake, and dietary guidelines should be 2-3 cups per day. This quantity meets the respondent's overall

consumption pattern of vegetables. At once a week, 25 % of respondents use the intake of cauliflower, broccoli, and cabbage. These vegetables contain a high antioxidant that helps to improve the immune system.

There is a correlation ( $p < 0.04$ ) between antioxidants and BMI levels. 52% of respondents found a higher BMI following 19% with overweight, 26% with pre-obese, and 7% with obese. A higher BMI value means an improper consumption pattern of fruits and vegetables. 54% of the respondent acknowledged about balanced diet despite the number of higher BMI is in increasing mode. A higher level of BMI has a high chance of non-communicable diseases such as hypertension, diabetes, cardiac disease, etc.

In Nepal, the Drugs Department Administration (DDA, 2019) monitors the production of antioxidants as medicines. As per Food supplements/Dietary supplements of vitamins and tonic's chemical composition should be formulated under the Drugs Act (2035). During monitoring, there were some complaints regarding the quality. The intake of fruits and vegetables seems low because of pesticides.

The policy should enhance produce antioxidant foods, especially fruits that support farmers economically. The commercial production of fruits is urgent. Unfortunately, people are less interested in the agricultural sector because of different issues such as the inadequacy of working manpower, fertilizer, market management, food price fluctuation, land fragmentation, and migration (Chaudhary, 2018). The policy needs to be encouraged local production of a variety of fruits available in easy and cheap ways through market development. For instance, apples and *Lapsi* (Log-plum) that are produced in rural villages can be produced in a variety of juices for commercial purposes. These fruits are rich in vitamin C. Nepal is rich in antioxidant food and is expert/skillful in making a variety of dishes with a single particular ingredient. The major thing is the awareness of fruits for daily intake.

## **Conclusion**

The role of antioxidants in health is critical. The importance of antioxidants is obvious as it helps in controlling 'ROS' (Reactive Oxygen Species) in the body. Also, it contribute to reduce mental stress. Nepal is rich in

antioxidants foods but its practice is not satisfactory due to various factors such as poor purchasing capacity, and nutrition knowledge that hinder the consumption of fruits. It visibly implies policy intervention and supports in terms of awareness and market.

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