

Date	Submitted	Accepted	Published
	26 th January 2026	24 th March 2026	9 th April 2026

AVAILABILITY, QUANTITY AND COST OF CALCIUM SOURCE FOODS FOR MEETING DAILY REQUIREMENTS AMONG WOMEN OF REPRODUCTIVE AGE IN HAWASSA CITY, SIDAMA REGION, ETHIOPIA

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ABSTRACT

Ethiopian women of reproductive age take less calcium than the recommended 1000 mg per day, such as 633 mg in Southern Ethiopia and 501 mg nationally. This deficit of 367 to 499 mg constitutes a public health issue since low calcium intake raises the risk of pregnancy-induced hypertensive disorders, a major cause of maternal mortality. The current study evaluated low-cost foods available in local markets that can be used to bridge this calcium gap. Commonly consumed foods in Hawassa city were purchased. Information on price of each food item was collected from three randomly selected vendors in the main market and supermarkets in three sub-cities. Calcium content was calculated using the updated 2025 Ethiopian food composition table. For vegetables, fruits and fish, edible portions were measured. A total of 12 food groups and 76 food items were identified and analysed. Group level analysis showed that spices and condiments had the highest average calcium content (659 mg/100 g), followed by pulses, seeds and nuts (252 mg/100 g) and vegetables (159 mg/100 g), with wide variation within all groups highlighting the need for item-level analysis to identify the most cost-effective sources for addressing dietary calcium gaps. Sesame seeds (25.3-34.4 g), moringa powder (59.1-80.4 g), kale (86.6-117.7 g), red and white finger millet (94.3-141 g), Niger seed (110.9-150.8 g), soybean (154.9-210.6 g) and chickpeas (167.6-227.9 g) provided the highest calcium in small quantities. For costing, sesame (6:33-8.60 ETB), red and white millet (8.81-12.22 ETB), kale (10.05-13.66 ETB), soybean (17.55-23.86 ETB), sweet potato (17.64-24.0 ETB), kidney beans (17.84-24.26 ETB), and Swiss chard (17.84-24.26 ETB) were the cheapest sources. Sesame, kale and finger millet provided the most calcium for the smallest consumption quantity and lowest cost. Despite their calcium content and relative affordability, non-energy providing food items (such as tea, spices, condiments) and moringa powder contribute little to actual intake due to their limited consumption. Sesame, finger millet, and kale are the most affordable and efficient foods to fill the dietary calcium gap, followed by soybean and chickpeas. Anti-nutrients might be a concern particularly for sesame and finger millet; however, common household processing methods such as fermentation can enhance calcium bioavailability. Food choices need to be guided by affordability, culture and sustainability in promoting calcium intake.

Key words: calcium, dietary gap, Hawassa, sesame, finger millet, kale, soybean, chickpeas

Citation: Omer A, Mulualem D, Boshe B, Tessema M, Amare E, Tefera N and SJ Whiting Availability, Quantity and Cost of Calcium Source Foods for Meeting Daily Requirements Among Women of Reproductive age in Hawassa City, Sidama Region, Ethiopia. *Afr. J. Food Agric. Nutr. Dev.* 2026; **26**(3): 29235-29262. <https://doi.org/10.18697/ajfand.150.26920>

INTRODUCTION

A daily calcium intake of 1000 mg for women of reproductive age is currently recommended [1]. Low calcium intake negatively impacts bone health, leading to conditions such as fractures, osteopenia, and osteoporosis in adults and rickets in children. Adequate calcium intake also offers other health benefits, such as reducing the risk of preeclampsia, maternal morbidity and preterm birth [2].

Worldwide, many Asian countries report intakes below 500 mg/day, while African and South American countries generally have low calcium intake between 400 and 700 mg/day [3]. In Ethiopia, the average calcium intake among women aged 15-45 years is 501 mg/day nationally and 633mg//day in Southern Ethiopia [4]. This results in deficits of 499 mg/day and 367 mg/day, respectively, relative to the recommended dietary allowance.

Dairy products such as milk, yogurt and cheese as well as non-dairy foods including canned fish and kale are rich sources of calcium [5]. Nutrition education programs often promote locally available calcium sources like kale, millet and eggshells. For the latter, in Halaba, community-based initiatives have studied the use of eggshell powder as a calcium supplement [6, 7]. The 2025 Ethiopian Food Composition Table (EFCT) identifies the many locally available foods with high calcium content, including millets, chickpeas, soybeans, kale, and seeds like linseed, Niger seed and sesame [8]. The focus needs to be on foods that are familiar or culturally acceptable and affordable within the household budget. Another consideration for Ethiopian women, is the presence of dietary inhibitors that reduce calcium bioavailability.

Beyond its essential roles including metabolism, skeletal and dental health, neuromuscular function, and blood coagulation, calcium may also help mitigate dental, skeletal and non-skeletal fluorosis. Dietary calcium binds with fluoride in the gastrointestinal tract and can impede its intestinal absorption [7]. Drinking water and foods grown in the Ethiopian Rift Valley often contain high levels of fluoride, resulting in fluoride intakes exceeding World Health Organization's recommendations and increasing the risk of dental, skeletal and non-skeletal fluorosis [9, 10]. Evidence on locally available foods that could help close the dietary calcium gap among Ethiopian women of reproductive age remains limited.

Moreover, economic constraints and the relative high prices of nutrient-dense foods have been identified as major drivers of suboptimal diets including calcium source foods in East Africa, suggesting that affordability must be considered alongside nutritional value when designing dietary recommendations and food-based interventions [11]. This study therefore aimed to estimate the quantities and costs of locally available calcium-rich foods required to meet the Recommended Dietary

Allowance (RDA) for Ethiopian women of reproductive age in Hawassa city, located in the southern Ethiopia Rift Valley.

MATERIALS AND METHODS

Study Design and Setting

This was a cross-sectional study conducted in Hawassa city, the capital of the Sidama Region, Ethiopia. Hawassa, a city of 577,000 people, is located between 6°55' and 7°3' North latitude and 38°25' and 38°34' East longitude, on the fringes of the Great Ethiopian Rift Valley. It is one of the fastest growing cities in Ethiopia, due to industrial development leading to increased rural-to-urban migration [12]. Hawassa is administratively divided into eight sub-cities and has a food retail environment composed of three major open markets and an expanding network of retail outlets, including supermarkets. The city's diverse socioeconomic composition and rapidly evolving urban food environment provide access to a wide range of locally available foods; thus, it is a relevant urban setting for assessing the availability and cost of calcium-rich foods required to meet dietary recommendations among women of reproductive age.

Sampling Technique

Hawassa Main Market (Old Market) was purposively selected as it is the largest and primary retail food market in the city. Stalls within Hawassa Main Market were selected using systematic random sampling. Vendors were then randomly selected from the first, middle and last rows of the selected stalls to account for potential price variation across the market. To collect price data for foods not typically available in open markets (for example imported products), supermarkets (larger stores) were also included. Three sub-cities (Menaharia, Tabor and Bahil Adarash), were purposively selected because they have the largest population and the highest concentration of supermarkets. One supermarket from each sub-city was then randomly selected to obtain prices for imported food items, including pasteurized milk, cottage cheese, tuna and rice.

Data Collection Procedure and Tools

A market survey was conducted in March 2025 at the Main Market and selected supermarkets to assess the availability and price data of calcium-source foods. Initially, only foods previously identified as calcium-rich [14] were targeted; however, the list was expanded to include spices, powders and other commonly purchased foods. The Ethiopian Food Composition Table (EFCT) was used to obtain calcium contents per 100 g of edible portion [8].

A standardized checklist was developed to guide the collection of food price data across the main market and supermarkets. Food items were purchased in the smallest possible quantity (≥ 0.25 kg) directly from vendors and supermarkets to

ensure accurate and realistic price data. Price data for all food items were collected from three different vendors to account for price variation, and the average price was calculated for each item. Prices were recorded in Ethiopian Birr (ETB). Fish prices were assessed by purchasing fish at commonly observed price points from areas around Lake Hawassa where fish is typically sold. To reflect typical purchasing practices, food items were purchased in their raw and unprocessed form.

After collecting price information for the purchased quantities of each food item (typically 250 g or 500 g), the cost was recalculated proportionally to estimate the price per 100 g. For several food items, including fresh rue, fresh maize stalk, raw and fried fish, kale, cabbage, celery, Swiss chard, sweet potato, taro and fruits, the edible portion was separated before calculating the cost per 100 g. These food items were processed in the nutrition laboratory of the School of Nutrition, Food Science and Technology at Hawassa University. First, the edible portion was separated from the total purchased quantity and weighed using a calibrated electronic balance (model WT100001X; maximum capacity: 10 kg; precision: 0.1 g). The cost of the purchased food item was considered to represent 100 g of edible portion.

The calcium content of each food item per 100 g was obtained from the EFCT. The quantity of each food required to provide 367 mg and 499 mg of calcium, representing the calcium intake gaps in southern Ethiopia and at the national level, respectively, was calculated. Then the cost of each food required to supply the specified amount of calcium could be estimated.

Data Quality Assurance

Data collection was conducted by trained data collectors under the supervision of a senior nutrition expert. The electronic weighing scale was checked for accuracy and consistency using a standard weight. Separation and weighing of edible portions were performed by an experienced nutritionist from Hawassa University. Technical oversight was provided by two experienced nutritionists to ensure consistency in data collection, verification of measurements and overall data quality.

Data Processing and Analysis

Data were entered into Microsoft Excel and transferred to Statistical Package for the Social Sciences (SPSS) version 25 for analysis. Descriptive statistics were used to summarize the calcium content of food items and the amounts required to close the dietary calcium gap. Based on a recent national survey [4], the dietary calcium gap was estimated at 367 mg/day for southern Ethiopia and 499 mg/day at the national level, relative to the RDA of 1000 mg/day. The quantities and associated costs of foods required to fill this gap were then estimated by individual food items and food groups. In addition, the calcium bioavailability of foods requiring consumption

quantities within the recommended intake amount and incurring the lowest cost was assessed.

RESULTS AND DISCUSSION

A total of 76 calcium source food items commonly purchased in Hawassa city were identified. Based on the Global Individual Food Consumption Data Tool [13], these items were classified into twelve groups. More than half of the food items (57%) fell into food groups of cereals, legumes (pulses, seeds and nuts) and spices and condiments. Tables 1 and 2 present food items classifying as core, energy providing and non-core non-energy providing groups and ranking by their calcium content from high to low. Most items providing the highest calcium per 100g were from the spices and condiments group (non-core non-energy providing), with the exception of sesame seeds.

Among the core energy providing foods, kale and celery from vegetables, millets from cereals, Niger seed and linseed from oil seeds and soybean and kidney bean from legumes contain the highest calcium content (219-424 mg) next to sesame. Kidney bean, teff (both red and white), milk and broad bean follow with calcium content ranging from 100 mg for broad bean to 144 mg for kidney bean. Beef, goat meat and Nile tilapia (meat and fish), beet root, taro and potato (root crops), tomato and zucchini (vegetables), avocado, mango, banana and papaya (fruits), and sorghum, barley, rice, maize (cereals) provide the least calcium (Table 1). This illustrates that all food groups provide calcium but selected vegetables, cereal and legumes are top food groups.

Although spices, condiments, moringa and tea leaves are rich in calcium, they are consumed in small quantities (Table 2). Spices and condiments are not consumed as stand-alone foods but are added to enhance flavor [14]. Moringa powder is usually sprinkled on meals and into drinks to enhance nutrient content and sometimes for medicinal benefits [15]. Tea leaves are typically used in very small quantities (2-3 grams per 250 mL of water) and contain high levels of oxalate and fluoride that prevent absorption of calcium [16].

Analysis of food quantity to fill the dietary calcium gap

The amount of food required to fill the daily calcium gap was calculated. The foods were ranked by intake quantity (from least to highest). Sesame had the smallest intake quantity to fill the dietary shortfall (25.3-34.4g) followed by moringa powder (59.1-80.4g), kale (86.6-117.7g), millet (94.3-141g), Niger seed (110.9-150.8g), celery (115.8-157.4g), soybean (154.9-210.6g), linseed (161.7-219.8 g) and chickpeas (167.6-227.9g). Kidney beans, teff (red and white), cow milk, cottage cheese and broad beans can fill the dietary gap with larger intake amounts ranging from 255g for kidney beans to 499g for broad beans (Table 1). Spices and

condiments were found to provide sufficient calcium to close the dietary gap with just a small quantity of consumption compared to most core energy foods (Table 2). In contrast, tomato, avocado, potato, zucchini, rice, maize, goat meat and banana required a large consumption (4078-9980g) (Table 1).

The quantity of kale, millet (red and white), celery and teff (red and white) and cow milk (fresh) required to fill the dietary calcium gap were in agreement with Ethiopian Food based dietary guidelines (EFBDG) [17]. While celery is considered a vegetable in EFBDG, it is specifically consumed in small amounts as a flavoring agent in Ethiopia [18]. Similarly, moringa powder is consumed only as a few grams per day [15]. The EFBDG advises an intake of 10-20 grams of oil seeds, and this amount can make a significant contribution toward filling the calcium gap for most oil seeds.

Plant-based foods were found to be the most important calcium sources that can provide sufficient amounts of calcium even when consumed in small amounts. Cereals, legumes and leafy vegetables are the main calcium sources for non-pastoralist Ethiopians where dairy consumption is relatively low [4]. Similar findings were reported in Uganda, where locally available cereals, legumes and leafy vegetables were identified as key contributors to calcium intake among nutritionally vulnerable populations [19]. However, these foods may contain oxalates and phytates that can reduce calcium absorption [20]. In contrast, populations in high-income Western countries typically obtain the majority of their dietary calcium from dairy products such as milk, cheese and yogurt, reflecting differences in dietary traditions, and food systems [21]. These differences highlight the importance of developing context-specific dietary strategies that emphasize locally available plant foods in regions where dairy intake is limited or unaffordable.

Cost analysis of foods to fill the dietary calcium gap

Sesame seeds, millet and kale were the least expensive food items costing between 6.33 and 13.66 ETB per day, whereas rice, fish, avocado, beef and goat meat were the most expensive options when used as primary calcium sources (Table 3). The cost of non-core non-energy providing food items varied widely ranging from 7.75 to 286.50 ETB per day (Table 4). Sesame, millet and kale food items seem to be affordable (less than 14 birr a day) for the majority of the population including those classified under food absolute poverty line (4348 ETB per year per adult) [22]. This finding suggests that improving calcium intake in resource-constrained settings may be achievable through careful selection of locally available foods. Soybean, sweet potato, kidney bean, Swiss chard, Niger seed, chickpeas and cow milk (fresh) were relatively cheap calcium source foods. Although these foods can be relatively inexpensive, large quantities such as 705.8 to 959.6 g of sweet potato and 1184 to 1610 g of cabbage are required, making them impractical for fulfilling the calcium gap. This highlights the need to consider both intake quantity and cost of food items.

Studies in East Africa provided similar conclusions that achieving nutrient adequacy requires balancing nutrient density, affordability and acceptable portion sizes [19]. Only six items out of 76 met both criteria of low cost and feasible intake quantity to fill the dietary calcium gap, aligning with EFBDG recommendations: sesame seeds, kale, millet, soybeans, chickpeas and fresh cow milk.

The cost of a healthy diet in Southern Ethiopia and at national level is 84.8 and 94.4 ETB [23]. The costs of sesame, millet and kale needed to compensate the calcium gap are 9.11%, 12.9% and 14.5%, respectively, of the cost of a healthy diet in Ethiopia. In contrast, soybean, chickpeas and cow milk accounted for 25.3%, 29% and 32.8% of the cost, respectively, raising concerns about their cost effectiveness for meeting calcium requirements. These findings are consistent with broader evidence showing that the cost of nutrient-rich foods often represents a key constraint to achieving healthy diets in low- and middle-income countries [24].

Bioavailability of calcium

Sesame seed is classified as a food with low calcium bioavailability (3.5-4.2%) [25] due to high content of antinutritional factors including oxalate, phytate and tannins [26, 27, 28]. Despite being low-cost and a good source of calcium, its low calcium bioavailability makes them a less effective choice for addressing the calcium gap. Kale is a widely consumed green leafy vegetable having bioavailable calcium (42.7%) [20], due to low oxalic acid content of vegetables; in contrast spinach and Swiss chard contain substantially higher levels [29, 30]. Cabbage has bioavailable calcium (47.3%) higher than milk (32.1%) [20], however, due to its low total calcium content, cabbage contributes less to dietary calcium intake than kale or milk. Finger millet has a calcium bioavailability of 28.6% [31], due to high phytate and oxalate content [32]. However, its high calcium content (354-389 mg/100g) compensates for this, providing a comparable [20], or even higher calcium intake [31] than milk in a similar serving size. Finger millet supplementation has demonstrated health improvements in children [31] and women [33].

Common household processing methods like fermentation, germination, malting and soaking reduce phytate and tannin levels [34] and enhance calcium bioavailability [31]. Application of such food processing techniques is a recommended strategy to improve calcium retention [35]. In Ethiopia, finger millet is primarily consumed as “injera” and bread through fermentation [36], presenting a substantial advantage for meeting women’s calcium needs at reduced costs. Moreover, finger millet can grow under arid and semi-arid regions, and has a long storage period, which makes it a plausible food item in harsh environments [37]. Unfortunately, finger millet is seen as a ‘food of the poor’ and thus is underutilized, warranting extensive nutrition promotion [36].

Soybean is classified as a food with medium calcium bioavailability (11.1%) [25], due to the presence of oxalate that hinders calcium absorption [38]. While soybeans contain more calcium than chickpeas, the latter exhibit a better calcium bioavailability (27%) than soybeans [20]. Most of the seed calcium in chickpeas is located in the seed coat, necessitating consumption of whole seed, and processing chickpeas reduces phytates and tannins [39].

Group level analysis of consumption quantity and cost

Analysis by food group revealed major variation in calcium content and the cost of meeting dietary needs (Table 5). This highlights the limitations of relying solely on broad food group recommendations. Food group level data can obscure optimal solutions to address calcium intake gaps. This underscores a vital public health strategy: for some nutrients such as calcium, it is prudent to move beyond broad food group recommendations to identify and promote specific, locally available and culturally acceptable calcium-dense foods.

There is growing evidence that eggshells, often considered household waste, are sustainable and highly bioavailable source of calcium, comparable to commercial calcium carbonate supplements [40]. A quantity of 0.9–1.25 g of eggshell powder can provide 367–500 mg of calcium, effectively addressing dietary deficiencies, particularly among women of reproductive age [41]. Powdered eggshell is well tolerated [42]. It is used in food and supplement industries [43], but household utilization remains limited. A community-based trial in Ethiopia demonstrated the practicality and broad acceptance of eggshell powder utilization at household level [6].

LIMITATIONS

There were some limitations to this study. Data collection coincided with the major fasting periods of both Orthodox Christians and Muslims, which likely inflated prices for selected food items, particularly vegetables. Ethiopia exhibits seasonal food price fluctuation and the study's single-timepoint data collection may not be generalizable to other periods. Finally, the cost analysis relied exclusively on market data from Hawassa city. However, these findings may be applicable in areas where the same food items are available and culturally acceptable.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

This study identified sesame seeds, kale, millet (red and white), soybean, and chickpeas as the most efficient sources to fill the dietary calcium gap (367–499 mg/day), in the smallest intake quantities (25.3–227.9 g/day). Cost analysis revealed that sesame, millet, and kale were the most affordable options (6.33–13.66 ETB/day), making them feasible for low-income populations. Of these, millet and

kale offered an additional advantage of higher calcium bioavailability. Finger millet emerged as particularly strategic for resource-limited settings due to its climate resilience, affordability, high calcium content and enhanced bioavailability through traditional fermentation. However, strong nutrition promotion efforts are needed to overcome negative cultural perceptions towards finger millet and promote its wider consumption. For high-risk groups (for example, pregnant and lactating women) in regions with limited access to calcium rich foods, fortification of staples may serve as a complementary strategy.

ACKNOWLEDGEMENTS

The authors acknowledge the School of Nutrition, Food Science and Technology at Hawassa University for granting permission to use its Nutrition laboratory for food processing (separation of edible portions) and weighing.

Funding sources: The authors received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest Statement: The authors do not have any conflict of interest.

Data availability statement: The authors will provide the raw data supporting this article's conclusions on request.

Ethics Statement: This research did not involve human participants, animal subjects, or any material that requires ethical approval. Informed consent was not also required

Table 1: Quantity of intake required to fill dietary calcium gap among women of 15-49 years of age, Hawassa city, Sidama Region, Ethiopia: Core and energy foods

	Food items	Food group	Calcium per 100g	Dietary calcium gap	
				367 mg	499 mg
				Required Intake (g)	Required Intake (g)
1	Sesame seed, whole, dried, raw	Nuts and seeds	1450	25.31	34.41
2	Kale	Vegetable	424	86.56	117.7
3	Millet-red-whole	Cereal	389	94.34	128.3
4	Millet-white-whole	Cereal	354	103.7	141.0
5	Niger seed	Nuts and seeds	331	110.9	150.8
6	Celery-raw	Vegetable	317	115.8	157.4
7	Soybean raw	Legume	237	154.9	210.6
8	Linseed	Nuts and seeds	227	161.7	219.8
9	Chickpeas, whole grain	Legume	219	167.6	227.9
10	Kidney bean-whole-dried	Legume	144	254.9	346.5
11	Teff red	Cereal	143	256.6	349.0
12	Teff white	Cereal	131	280.2	380.9
13	Cow milk, fresh	Milk and dairy product	125	293.6	399.2

14	Cottage Cheese, cow	Milk and dairy product	106	346.2	470.8
15	Broad bean-whole-dried	Legume	100	367.0	499.0
16	Peas whole-dried	Legume	98	374.5	509.2
17	Swiss chard	Vegetable	85	431.8	587.1
18	False banana-kocho	Starchy root	82	447.6	608.5
19	Cow milk, pasteurized, fat reduced, unfortified	Milk and dairy product	80	458.8	623.8
20	Lentil, whole, dried	Legume	68	539.7	733.8
21	Peas split, dried	Legume	64	573.4	779.7
22	Egg, from local chicken	Egg	60	611.7	831.7
23	Sweet potato-raw	Starchy root	52	705.8	959.6
24	Pumpkin seed	Nuts and seeds	50	734.0	998.0
25	Green beans	Vegetable	41	895.1	1217
26	Wheat, whole, dried	Cereal	39	941.0	1279
27	Wheat white, flour	Cereal	39	941.0	1279
28	Egg, from exotic breed hens	Egg	38	965.8	1313
29	Lentil split, dried	Legume	36	1019	1386
30	Cabbage	Vegetable	31	1184	1610
31	Carrot	Vegetable	31	1184	1610

32	Barley, black, whole grain	Cereal	28	1311	1782
33	False banana-bulla	Starchy root	27	1359	1848
34	Onion	Vegetable	25	1468	1996
35	Sorghum, white, whole grain	Cereal	19	1932	2626
36	Nile tilapia, fresh water, fillet, grilled (No salt)	Meat, poultry fish	18	2039	2772
37	Sorghum, red, whole grain	Cereal	17	2159	2935
38	Barley, white, whole grain	Cereal	17	2159	2935
39	Beef, lean meat	Meat, poultry fish	17	2159	2935
40	Beetroot	Root crop	17	2159	2935
41	Taro raw, peeled	Root crop	17	2159	2935
42	Papaya	Fruits	15	2447	3327
43	Nile tilapia, freshwater fish, fillet, raw	Meat, poultry fish	14	2621	3564
44	Mango-fresh	Fruit	12	3058	4158
45	Rice imported	Cereal	10	3670	4990
46	Tomato	Vegetable	9	4078	5544
47	Avocado-fresh	Fruit	9	4078	5544
48	Potato Irish-raw	Root crop	8	4588	6238
49	Tuna fish, canned in oil	Meat, poultry fish	8	4588	6238

50	Zucchini fresh	Vegetable	8	4588	6238
51	Rice, white	Cereal	6	6117	8317
52	Maize, white, whole grain	Cereal	5	7340	9980
53	Maize, white, fresh whole grain	Cereal	5	7340	9980
54	Goat meat	Meat, poultry fish	5	7340	9980
55	Banana	Fruit	5	7340	9980
56	Sunflower oil	Fat and oil	0	0.0	0.0
57	Soybean oil	Fat and oil	0	0.0	0.0
58	Palm oil	Fat and oil	0	0.0	0.0

Table 2: Quantity of intake required to fill dietary calcium gap among women of 15-49 years of age, Hawassa city, Sidama Region, Ethiopia: Non-core, non-energy foods

	Food items	Food group	Calcium per 100g	Dietary calcium gap	
				367 mg	499 mg
				Required Intake (g)	Required Intake (g)
1	Rue- dried, seed	Spices and condiments	1970	18.63	25.33
2	Sacred basil, dried	Spices and condiments	1500	24.46	33.27
3	Cummin, white	Spices and condiments	955	38.43	52.25
4	Coriander, dried	Spices and condiments	846	43.38	58.98
5	Cloves, dried	Spices and condiments	663	55.35	75.26
6	Cinnamon-dried	Spices and condiments	661	55.52	75.49
7	Moringa powder	Vegetable	621	59.10	80.35
8	Mustard seed	Spices and condiments	527	69.64	94.69
9	Cummin black dried	Spices and condiments	496	73.99	100.6
10	Tea leaf, dried	Beverages	478	76.78	104.4
11	Garlic, dried	Spices and condiments	393	93.38	127.0
12	Cardamom-dried	Spices and condiments	345	106.4	144.7
13	Rue- fresh, seed	Spices and condiments	331	110.9	150.8

14	Chilli powder	Spices and condiments	330	111.2	151.2
15	Ginger powder	Spices and condiments	152	241.5	328.3
16	Fenugreek	Spices and condiments	54	679.6	924.1
17	Garlic –fresh	Spices and condiments	49	749.0	1018
18	Ginger root, fresh	Spices and condiments	19	1932	2626

Note: In powder form, moringa is usually used as a sprinkle; thus, grouped as non-core non-energy providing despite its nutrient content

Table 3: Cost of food items to fill dietary calcium gap among women of 15-49 years of age, Hawassa city, Sidama Region, Ethiopia: Core and energy foods

	Food item	Food group	Dietary calcium gap			
			367mg		499mg	
			Required Intake (g)	Cost of food (ETB)	Required Intake (g)	Cost of food (ETB)
1	Sesame seed, whole, dried, raw	Nuts and seeds	25.31	6.33	34.41	8.60
2	Millet-red-whole	Cereal	94.34	8.81	128.3	11.97
3	Millet-white-whole	Cereal	103.7	8.98	141.0	12.22
4	Kale	Vegetable	86.6	10.05	117.7	13.66
5	Soybean raw	Legume	154.9	17.55	210.6	23.86
6	Sweet potato-raw	Starchy root	705.8	17.64	959.6	23.99
7	Kidney bean-whole-dried	Legume	254.9	17.84	346.5	24.26
8	Swiss chard	vegetable	431.8	17.84	587.1	24.26
9	Niger seed	Nuts and seeds	110.9	19.96	150.8	27.14
10	Chickpeas, whole grain	Legume	167.6	20.11	227.9	27.34
11	Cow milk, fresh	Milk and dairy product	293.6	22.80	399.2	31.01
12	Teff red	Cereal	256.6	35.07	349.0	47.69

13	Teff, white	Cereal	280.2	39.22	380.9	53.33
14	Cabbage	Vegetable	1184	42.83	1610	58.24
15	Broad bean-whole-dried	Legume	367.0	44.04	499.0	59.88
16	Peas, whole-dried	Legume	374.5	55.55	509.2	75.53
17	Carrot	Vegetables	1184	56.51	1610	76.83
18	Linseed	Nuts and seeds	161.7	56.59	219.8	76.94
19	Cow milk, pasteurized, fat reduced, unfortified	Milk and dairy product	458.8	57.90	623.8	78.73
20	Beetroot	Root crop	2159	71.96	2935	97.84
21	Onion	Vegetable	1468	75.85	1996	103.1
22	Wheat, whole, dried	Cereal	941.0	78.42	1279	106.6
23	Taro raw, peeled	Root crop	2159	86.35	2935	117.4
24	False banana-kocho	Starchy root	447.6	89.51	608.5	121.7
25	Wheat white, flour	Cereal	941.0	90.97	1279	123.7
26	Peas split, dried	Legume	573.4	110.9	779.7	150.7
27	Sorghum, white, whole grain	Cereal	1932	135.2	2626	183.8
28	Sorghum, red, whole grain	Cereal	2159	151.1	2935	205.5
29	Lentil, whole, dried	Legume	539.7	161.9	733.8	220.1
30	Barley, black-whole grain	Cereal	1311	172.6	1782	234.6

31	Green beans	Vegetable	895.1	179.0	1217	243.4
32	Tomato	Vegetables	4078	203.9	5544	277.2
33	Barley, white, whole grain	Cereal	2159	208.7	2935	283.7
34	Potato Irish-raw	Root crop	4588	214.1	6238	291.1
35	Celery-raw	Vegetable	115.8	214.1	157.4	291.1
36	Egg, from local chicken	Egg	611.7	289.0	831.7	392.9
37	Lentil split, dried	Legume	1019	299.0	1386	406.6
38	Egg, from exotic breed hens	Egg	965.8	306.6	1313	416.9
39	Maize, white, whole grain	Cereal	7340	330.3	9980	449.1
40	Papaya	Fruits	2447	360.5	3327	490.1
41	Pumpkin seed	Nuts and seeds	734.0	367.0	998.0	499.0
42	Cottage Cheese, cow	Milk and dairy product	346.2	398.7	470.8	542.1
43	False banana bulla	Starchy root	1359	407.8	1848	554.4
44	Zucchini, fresh	Vegetable	4588	414.4	6238	563.5
45	Mango-fresh	Fruits	3058	566.8	4158	770.6
46	Nile tilapia, freshwater fish, fillet, raw	Meat, poultry fish	2621	645.1	3564	877.1
47	Maize, white, fresh whole grain	Cereal	7340	717.1	9980	975.0
48	Banana	Fruits	7340	724.5	9980	985.0

49	Rice, white	Cereal	6117	734.0	8317	998.0
50	Rice imported	Cereal	3670	807.4	4990	1098
51	Nile tilapia, fresh water, fillet, grilled (No salt)	Meat, poultry fish	2039	2295	2772	3120
52	Avocado-fresh	Fruits	4078	2571	5544	3496
53	Beef, lean meat	Meat, poultry fish	2159	3454	2935	4696
54	Goat meat)	Meat, poultry fish	7340	10280	9980	13970
55	Tuna fish, canned in oil	Meat, poultry fish	4588	11680	6238	15880
56	Soybean oil	Fat and oil	0.0	0.00	0.0	0.00
57	Sunflower oil	Fat and oil	0.0	0.00	0.0	0.00
58	Palm oil	Fat and oil	0.0	0.00	0.0	0.00

Table 4: Cost of food items to fill dietary calcium gap among women of 15-49 years of age, Hawassa city, Sidama Region, Ethiopia: Non-core, non-energy foods

	Food item	Food group	Dietary calcium gap			
			367mg		499mg	
			Required Intake (g)	Cost of food (ETB)	Required Intake (g)	Cost of food (ETB)
1	Sacred basil, dried	Spices and condiments	24.47	7.75	33.27	10.53
2	Cummin white	Spices and condiments	38.43	11.53	52.25	15.68
3	Rue- dried, seed	Spices and condiments	18.63	20.49	25.33	27.86
4	Coriander dried	Spices and condiments	43.38	21.69	58.98	29.49
5	Rue- fresh, seed	Spices and condiments	110.9	24.23	150.8	32.94
6	Mustard seed	Spices and condiments	69.64	27.86	94.69	37.87
7	Tea leaf	Beverages	76.78	38.39	104.4	52.2
8	Cinnamon-dried	Spices and condiments	55.52	38.87	75.49	52.84
9	Cummin black dried	Spices and condiments	73.99	43.16	100.6	58.69
10	Moringa powder	Vegetable	59.10	59.10	80.35	80.35
11	Garlic, dried	Spices and condiments	93.38	65.37	127.0	88.88
12	Chilli powder	Spices and condiments	111.2	111.2	151.2	151.2

13	Cloves dried	Spices and condiments	55.35	138.4	75.26	188.2
14	Ginger powder	Spices and condiments	241.5	140.8	328.3	191.5
15	Cardamom-dried	Spices and condiments	106.4	184.4	144.6	250.7
16	Garlic –fresh	Spices and condiments	749.0	184.7	1018	251.2
17	Ginger root, fresh	Spices and condiments	1932	193.2	2626	262.6
18	Fenugreek	Spices and condiments	679.6	210.7	924.1	286.5

Note: 1 USD=ETB 124: Date: March 15, 2025

Source: Commercial bank of Ethiopia

Table 5: Grouping of calcium source foods commonly consumed in Hawassa city, Sidama Region, Ethiopia

	Food group	Number of food items	Average [range] calcium content mg/100 g	Average [range] cost of food to fill gap (ETB)
1	Cereals	14	86 [5–389]	251 [8.8–807.4]
2	Roots, tubers and plantains	6	34 [8–82]	148 [17.6–407.8]
3	Pulses, seeds and nuts	12	252 [36–1450]	98 [6.3–367]
4	Milk and milk products	3	104 [80–125]	40 [22.8–57.0]
5	Eggs	2	49 [38–60]	298 [289–306.6]
6	Fish	3	13 [8–18]	1470 [645–2295]
7	Meat and poultry	2	11 [5–17]	6865 [3454–10276]
8	Vegetables	10	159 [8–621]	127 [10.1–414]
9	Fruits	4	10 [5–15]	552 [360.5–724.5]
10	Fats and oils	3	0	n/a
11	Spices and condiments	16	659 [19–1970]	73 [7.75–210.7]
12	Beverages	1	478	38
	Total	76		

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