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## Production Stages of Berbere (Pepper Powder) in Ethiopia

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**ABSTRACT**

Red or dark red peppers are used to make Berbere (pepper powder), and various spices are used to bring more flavor and fragrance. Berbere is consumed as it is, and cooked with vegetables that are often used to make sauces (wet), pastes, and pickles throughout the country. In this study, the traditional production stages, equipment's, and sources of energy were described. The production stages, spices used as well as the raw materials utilized vary among households, villages and localities. Since the current study presents a flow chart of the various steps involved in producing stages of Berbere, it may be useful to people who wish to scale up Berbere processing in the future. Based on the finding of this survey, it is recommended to optimizing the processes.

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**Introduction**

Red pepper is subgroup of the plant genus *Capsicum*, which is a member of the Solanaceae family [1]. *Capsicum annum*, *C. baccatum*, *C. chinense*, *C. frutescens*, and *C. pubescens* are the five domesticated species of the genus *Capsicum*. The most widely grown pepper species in Ethiopia are *C. frutescens* and *C. annum* and both are mostly grown in Tigray, Gondar, Wollega, Illubabor, Keffa, Gamogofa, Bale, and Harerege [2]. Pepper is the most widely grown vegetable crop, accounting for approximately 67.53% of the total estimated area under vegetables in the country, whereas green pepper accounts for approximately 3.82% CSA.

Pepper has a long history in Ethiopia, far longer than any other vegetable [3]. Dark red pepper, which is valued mostly for its pungency, has privileged importance in Ethiopian culture. It has been grown and used in Ethiopia for a long time and is a staple of the Ethiopian diet. Hot chili pepper cultivars are cultivated across Ethiopia and are an important part of traditional food in most parts of the country. The mature fruits, which are usually hot or very hot, are dried and powdered. The powder is used in the hot, mixed spice Mitmita and the spicy sauce Awazi, both very frequently used. There are numerous cultivars of this species, with fruits ranging from sweet to pungent. The whole and cut fruits are used green in cooked dishes and raw as a component in the fasting food Beyayenetu. The ripe fruits are dried and powdered before being used in a spice blend known as Berbere [2].

Ethiopians are passionate about red pepper, which is prized for its great pungency and processed locally at home into berbere, which is eaten by the vast majority of the people. After removing the seeds, placenta sections, and stalks, the fruit can be crushed to

improve the color and reduce the pungency. The ripe dried fruits of capsicum have been used for the preparation of berbere flour. In the regular preparation of different Ethiopian sauces ('wet'), the fine pungent flour of red pepper ('berbere') is an essential flavoring and coloring component [4]. It is inextricably linked to practically every Ethiopian kitchen and the fourth most often consumed food item in Ethiopia. In Ethiopian society's every day to make the traditional sauce, the fine powdered pungent product is a crucial taste and coloring ingredient. The majority of Ethiopians food without red pepper to be inspired.

Ethiopia produces a wide variety of pepper varieties. Five red pepper varieties have been released by the Ethiopian Institute of Agricultural Research (EIAR), including mareko fana, melka awaze, melka zala, melka dera, and melka shote. Fruit features which include size, shape, color, and pungency vary depending on the growth conditions. These varieties are the highest marketable yield (Qt/ha), early flowering, and maturity, and are not easily affected by diseases and pests. Farmers commonly utilize Mareko fana and Melka zala varieties from this group. Mareko fana is about 19-centimeter height; it has a thick cover and irritating nature. Spice manufacturers such as Ethiopian Spice Factory are in high demand for this kind. Melka zola, on the other hand, has a reddish color and an extremely unpleasant cover, with a total height of around 13 centimeters [5].

Red pepper is the most widely grown vegetable crop, accounting for approximately 67.53% of the overall estimated area under vegetables in the country, while green pepper accounts for approximately 3.82% (Central Statistics Agency of Ethiopia, 2014). The average yield of red and green peppers is 66.88 and 23.31 quintals per hectare, respectively, and the annual production of red and green peppers is expected to be around 2,541,883.97

and 412,503.57 quintals. Ethiopia's probable pepper-producing regions are in the country's south, west, northwestern, and central regions. Currently, the southern area of Ethiopia produces the majority of the country's pepper products CSA, 2016 & 2017.

The Ethiopian Export Promotion Agency (EEPA, 2003) the land coverage for pepper production in Ethiopia accounts for 34% of the production of the total spice in Amhara, Oromia, and SNNPRS regions. Despite this, the system for the production of green and dry pod peppers has remained unchanged. Poor variety, poor cultural techniques, and the predominance of fungal, bacterial, and viral diseases have all contributed to the loss of red pepper production [6].

The most important quality parameters of peppers used in food preparation are color, pungency, and aroma. A variety of factors influence the color of dried red peppers, including cultivar, maturity stage at harvest, and subsequent drying, drying conditions, and the final moisture level. Pepper ripening requires a sequence of complex events, all of which are critical to the pepper's quality. The single most important commercial factor in terms of quality is the degree of ripening necessary for different markets. Harvesting at the proper maturity stage is critical for achieving optimal quality and maintaining that quality after harvesting. Immature peppers have a shorter shelf-life than mature peppers because of their relatively high respiratory and metabolic rates. Early harvesting is advantageous commercially in terms of maintaining quality during storage, handling, and transport, but it comes at the expense of flavor development during storage [7].

The color appears bleached when there is less than 10% moisture, while there is darkening when there is more than 10% moisture due to non-enzymatic browning. Because of the auto-catalyzed degradation of carotenoids, the color of crushed or ground peppers flour deteriorates faster than whole red peppers [1].

Physical appearance, including color change, is a very essential attribute for marketing or consumption purposes because customers are initially visually assessed to check the food quality. The consumer will reject the goods if it has an unexpected/unattractive color or a dramatic change in physical appearance. Undesirable biological or chemical reactions may occur during the drying of fruit due to the pigment degradation, Mallard reaction, enzymatic browning, and ascorbic acid oxidation, resulting in changes in color, texture, odor, or other qualities for the dried solid goods [8,9].

## Materials and Methods

A survey of production stages and raw materials used for the production of berbere was conducted using structured interviews and focus group discussions at 16 different locality in Ethiopia. Mekele, Gondar, Koladeba, Finoteselam, Bure, Adama, Arertie, Wolkite, Hosaena, Koeshe, Alaba, Azerenet, Hawassa, Butajira, Debre Birhan, and Addis Ababa are among the most berbere producer, household, and retailer areas. The interview questioner includes production stages, spices uses, and raw materials from the most berbere producer, household, and retailer areas. The interview was administered in Amharic language in the villages of each locality. Ten sit which are known for consumption (household) and producer of berbere were selected from each locality. A total of 160 persons were selected randomly for interview after preliminary screening. Data were collected on the preparation techniques, types of ingredients, sources of energy and types of equipment.

## Result and Discussion

In the production of berbere, red peppers go through several stages of production before being used as a sauce ingredient (wet). In different parts of the country, the production stage and spices used are different. Harvesting and/or purchasing red peppers from a retailer, drying, destalking, fading, toasting, and milling are all frequent production stages of berbere. Sun-drying is the most common drying method in berbere production and it takes a long time (Based On Weather Conditions).

### Stage I: Harvesting and Buying

In this stage, the ripened or ripe red peppers are harvested from the field. Human labor is used in the process, and different containers for the gathered items are used, such as baskets, bags, and blankets. Harvesting can take a long period depending on the location and the area of the grounds. In addition, the harvested products are not enough for the purpose the society may buy from the markets. However, in urban areas, the majority of the population purchases harvested crops from markets for their use.

### Stage II: Drying

Due to its ease of availability and accessibility, sunlight drying is a popular drying method in Ethiopia. Drying in the sunlight can take some days (7-20 days) to dry. It will mold before it dries if the humidity is high. Sun-drying necessitates consistent daytime exposure to direct sunshine and a relative humidity of less than 20%. For successful drying, low humidity, low heat, and sufficient air circulation are essential [10,11]. The peppers are placed on the flat surface material and rotated at regular intervals of time to reduce drying time.

### Stage III: Destalking

After the red peppers have dried completely, the undesirable stems are removed using traditional methods such as hands and sizers. Furthermore, the red pepper is pickled by human hands to remove undesirable elements, which affects the product's quality. It takes an hour to a day dependent on the amount, number, and speed of human labor is performed.

### Stage IV: Washing and Drying

In this stage, the red peppers are washed with water to remove the pesticide residue and dust which is intact on the body. This pesticide residue is potentially hazardous to people and depending on the amount and kind of exposure, it can cause both acute and chronic health problems. The peppers must also be free of dust clouds, or the product's quality and human health would suffer. Then washed red peppers are dried with sunlight until complete drying. However, the majority of respondents in the research did not wash their red peppers because they were unaware of the effect of the pesticide residue. As a result, pesticide residue is eliminated to safeguard food consumers from pesticide side effects.

### Stage V: Fading

In this stage, the clean dried red peppers are faded with different spices by mortar and pestle (mukecha and Zane Zena) until the required size is reached. The fresh and dried spices, such as cardamom, sacred basil, cumin (black), bishops weed, garlic, rue, rosemary, ginger, cinnamon, fenugreek, and other locally accessible spices, can be added to dry red pepper-based on individual preferences, culture, and economic situation. Mortar and pestle are used to blend the fresh spices until they are well mixed. Fresh spices and dried clean red peppers are blended, then faded with mortar and pestle till the desired size is achieved. The combination is kept in a sealed container for one day to allow the

spices and peppers to interact.

### Stage VI: Toasting

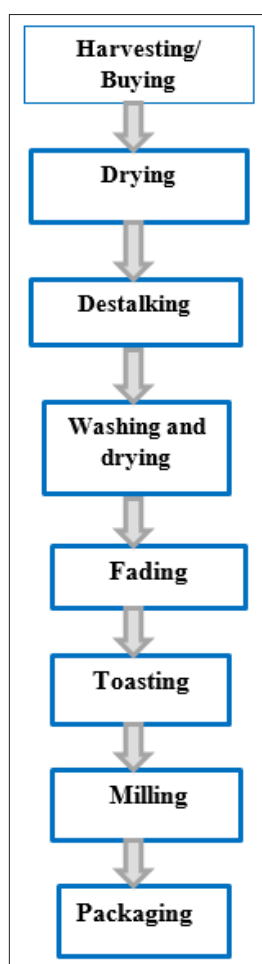
The fading peppers are exposed to the sun for complete moisture elimination and depending on the weather conditions it can take up to two days. After drying, the peppers are placed on a flat metal (biretmitad) to toast for 5-10 minutes at a low temperature (50-60°C). Toasting is used to remove any remaining moisture from the drying cycle.

### Stage VII: Milling

A miller grinds the complete dried pepper and dried spices till it reaches a fine powder. It is the last step in the berbere production stages. Milling can be performed either manually or automatically.

### Stage VIII: Packaging

Finally, the fine powder of berbere are enclosing or protecting it with a plastic container or any other.



**Figure 1:** Flow Chart of Berbere production (Ethiopian Spice)

In Ethiopia different spices are added to the red peppers to enhance the flavor, color, and aroma based on consumer preferences, accessibility, and economic situation. People have used different sources of energy and equipment to facilitate the production stages. The operation, source of energy, and equipment used in the production stage of berbere are listed in Table 1.

**Table 1: Operation, Source of Energy, and Equipment Utilized for Production Purpose of Berbere**

Operation	Source of Energy	Equipment
Drying	Sunlight	Blanket, Plastic sheets, animal hide, mats
Destalking and cleaning	Human powers	Sizers, Traditional flat trays (sefed), mates, baskets
Fading (medelez)	Human powers	Large mortal and pestle (mukecha) metal or wood, plastic metal bowls
Toasting (mames)	Fire /electricity	Flat metal (biret mitad, shekila mitad), wood, baskets, metal or stike rod
Milling	Electricity/ human power	Flour miller, grinding stones (woficho)
Sieving	Human power	Traditional sieve (wonfit) and Traditional flat trays (sefed)
Packaging	Human power	Small plastic/metal pots

### Conclusion

Berberere is a traditional spice blend that is the backbone of Ethiopian food status. Berbere is prepared from matured red or dark red peppers by adding different spices. It passes different production stages which includes harvesting and/ buying, drying, destalking, washing and drying, fading, toasting, milling and packaging.

### Ethics Statement

The studies involving human participants were reviewed and approved by Ethiopian Public Health Institute Ethical Approval Committee. The legal guardian of the participants gave written informed consent to participate in this study.

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### Conflict of Interest

The authors declare that the research was conducted in the absence of any financial relationships that could be construed as a potential conflict of interest.

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