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Original Paper

Quality and Adulteration in Ethnic Spices and Food Ingredients in Local Market

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***Abstract*—The quality of Food depends on the nature of the ingredients used to prepare it, if the ingredient remains in best eminence without any adulteration then only we can get the pure quality food. This study aimed to detect the quality and adulterants in commonly used food ingredients and spices from local markets of Kolhapur city of India, which are usually used to prepare local ethnic food. Some tests from (the Food Safety and Standards Authority of India) are performed to check adulterants like insoluble impurities, chalk powder, washing soda, red lead salts, brick powder, and artificial colors in food ingredients. 5 sugar samples, 8 chili powder samples, 3 Jaggery samples, 6 turmeric powder samples, 6 common salt samples, 2 black pepper samples, 2 ghee or butter samples, 3 dal samples, 3 wheat flour samples, 2 honey samples, 2 cinnamon samples, and 3 coffee powder samples were analyzed. 2 chili, 1 black pepper, 1 cinnamon, 1 Jaggery 1 Honey, and 1 coffee powder samples are found with adulterants whereas most were without adulterants. Most of the local food ingredients are of good quality.**

Keywords*— *food adulteration, food quality, local market, Spices, Kolhapur, India

I. INTRODUCTION

Food, shelter, and clothes are basic needs of human beings, among these, food is very important to live and therefore there is a necessity of quality food for healthy life. Traditional Indian foods have been prepared for many years and are diverse across the country. Traditional wisdom about the processing of food, its preservation techniques, and its therapeutic effects has been established for many generations in India [1]. In India there are various types of food & spices are used as it is very well-known for its diversity in cuisines which changes with each state/province. There is so much diversity in the traditional health foods of India because the regional health foods have evolved according to the climate, culture, and cropping practices of a particular region [1]. Kolhapur is a southwestern big agricultural region of India in Maharashtra state which features a good tradition of varied delicious local foods, especially local food ingredients, and spices. Kolhapur is which has a good tradition of various delicious local foods such as '*Tambada pandhra rassa'* means red and white curry /stock (fig 2, i) a very famous spicy dish served with non-vegetarian meals like chicken and mutton with the addition of several spices. *Missal* (fig. 2h), *Bhel, and Vada Pav are* very popular local vegetarian snacks with a fusion so many different spices made of a mixture of vegetables, fluffed rice, and potato with lentil batter respectively as well as many local vegetables and sweets.

Kolhapur is an agricultural region and grows all the necessary vegetables, spices, and other common ingredients which are considered to be fresh and best in quality. The quality of any food always depends on the quality and purity of ingredients and spices used to prepare it. Substances used in this region for food items are usually sugar, chili powder, Jaggery, turmeric powder, common salt, ghee/butter, black pepper, dal (lentils), cinnamon, wheat flour, honey, etc. So the study focuses on these common ingredients to check their quality and any adulteration.

Adulteration is defined as the process by which the quality or the temperament of a given substance is reduced through, the addition of a foreign or a substandard substance and, the removal of vital elements [2, 22], so in a precise way adulteration in food or ingredients mean "The addition or subtraction of any substance to or from food, so that the natural composition and quality of food material is affected". The substance that is used to lower the quality is known as adulterants [3]. When a non-permitted material is added to extend the number and quality of the spices then it's called adulteration.

So overall it is that 'Adulteration' means decreasing the quality of an article by adding or subtracting valuable components in it, increasing in weight, to enhance color quality and mainly for their economic benefit [4] [5].

Every food product attains its final profile predominantly from two components, namely, ingredients and processing methods [21]. Traditional Indian delicacies require varieties of spices to obtain a proper flavor profile from spices. The quality of ethnic cuisine is due to regional and ethnic practices and subjective factors such as the skill and style of the preparation [6].

Almost every food article from milk to fruits, from vegetables to grains is adulterated at some stage; some adulterants enter via the agricultural process, as they are not cleaned well, these are noticeable adulterants like stones, leaves, soil, sand, and dust to name a few [7].

Spice is a seed, fruit, root, bark, bud, or vegetable substance mainly used for flavoring, coloring, or preserving food. Common and rare spices have their particular adulterants that either are mixed while the preparation of the spices or completely replace the original spices [3].

Adulteration in food is frequently present in its most crude form as prohibited materials are either added partially or wholly substituted. Contamination or adulteration in food is added for various reasons which include financial gain, carelessness, and lack of proper hygienic conditions for processing, storing, transportation, and selling [8].

Hence, here study focuses on checking whether adulterants are present or not in ingredients that are prime ingredients to prepare many regional food items which will also reflect in food quality. Condition of declaration food as adulterated is legalized by the Indian government by the Prevention of food adulteration act and Rules, 2004 [4] and by Quick test for some adulterants in food, instruction manual 1 and 2, FSSAI-The Food Safety and Standards Authority of India [5] by follows: The components added decrease or injuriously affect it; Addition of extra material wholly or in part; Important nutrients are drawn wholly or in part or it is mimicry; Colorant added to improve appearance or if it contains any added substance injurious to health; and For whatsoever reason, its quality is below the standard. Following are the Quick tests for some adulterants in food by FSSAI [5] which are also used for the current study to check the quality of ingredients.

These food items are used by nearly every household every day in the form of food or food ingredients. Adulterants of food articles not only decrease the quality of food articles but if we eat these adulterated food substances daily, then it impacts our health very dangerously [9, 10].

Kolhapur has a good tradition of a variety of ethnic food menus as well as a local market for food ingredients and various spices used in food items, common ingredients used in food items are locally grown and used. People in Kolhapur consume them daily in their food intake. Adulteration causes serious effects on health as well as degrade the quality of food hence there is a need to detect adulterants in spices.

All the samples taken for the study are the commonly used ingredients for the preparation of different food items for daily and festivals day. Hence we have to know about the food quality provided by shopkeepers in the local market of the city. This study has objectives, first one is to detect adulterants in these food ingredients such as insoluble impurities, chalk powder, washing soda, red lead salts, brick powder, artificial color, Metanil Yellow, papaya seeds, starchy matter, Vanaspati ghee, lead chromate, Kesari dal, excessive bran, sand, dirt, sugar, water, cassia barks & chicory begins.

The second one is to check the quality of ingredients that are used to prepare food, which is also important to maintain the taste and legacy of traditional ethnic food quality. And the last one is, by giving suggestions with the help of this work as a reference to create awareness in people about adulterants present in substances available in the local market of Kolhapur.

II. Material And Methods

A. Area of Study

Kolhapur city is located 160 42' North and 740 14' East (Fig 1) covering 6682 hectors area. It has the Panchaganga river basin located in the northern part of the city. This study is conducted in three local markets of Kolhapur city. It is famous for various things like spicy food, sugarcane, Jaggery, milk, leather work, spices items, and as a historical place. Also known as 'Karveernagari.' a prominent tourist place due to the ancient temple of Goddess Mahalaxmi.

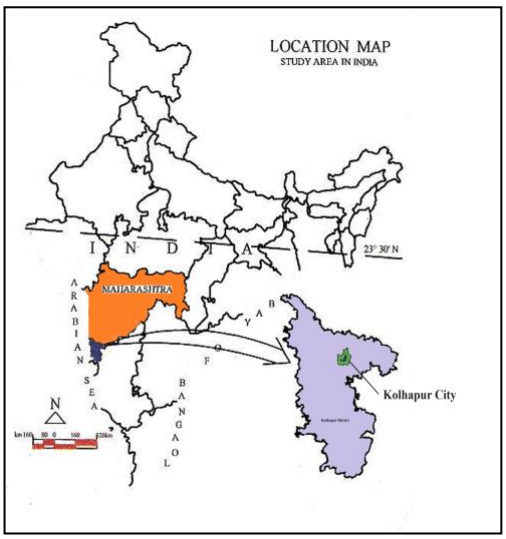

Fig. 1. Location map of the study area

B. Sample Size and Sampling Method

The sample is taken as per the seasonal availability of the different spices and ingredients in the year 2016 to 2018. 5 sugar samples, 8 chili powder samples, 3 Jaggery samples, 2 black pepper samples, 2 ghee or butter samples, 3 dal samples, 3 wheat flour samples, 6 turmeric powder samples, 6 salt samples, 2 honey samples, 2 cinnamon samples, 3 coffee powder samples were analyzed. A random sampling method was used to collect food ingredients from three markets of city.

Fig. 2. Different types of food ingredients in local markets and special local food of Kolhapur city a) chili and turmeric powder samples b) chili powder and other spices c) package samples of chili, turmeric, and flour d) salt samples e) sugar samples f) different spices g) Jaggery sample h) street food 'Misal paav' i) non-veg dish ‘ Tambada pandhra rassa’

TABLE I. VARIOUS TEST ANALYSIS METHODS, OBSERVATIONS, AND CONCLUSIONS FOR DIFFERENT FOOD INGREDIENTS AS PER [5] [11] [12].

Food Ingredients	Adulterants	Methods For Detection
Sugar	Various insoluble impurities	Take a small amount of sugar in a test tube and shake with little water. Pure sugar dissolves in water but insoluble impurities don't dissolve.
	Chalk powder& Washing soda	To a small amount of sugar in a test tube, add a few drops of diluted HCl. A brisk effervescence of carbon dioxide confirms the presence of chalk powder or washing soda in the given sample of sugar.
Chili Powder	Red lead salts	To a sample of chili powder, add dil. Nitric Acid. Filter the solution and add two drops of potassium iodide into it. Yellow ppt. indicates the presence of lead salts in chili powder.
	Artificial colorants, Brick powder, Sawdust	Sprinkle a spoonful sample on a glass of water. Artificial colorants will descend as colored streaks and brick powder will settle down. Sawdust will see in the water.
Jaggery	Metanil yellow	Take 1/4th of a teaspoon of Jaggery in a test tube. Add 3 ml of alcohol and shake the tube vigorously to mix up the contents. Pour 10 drops of HCl into it. A pink color indicates the presence of an adulterant.
Black Pepper	Papaya seeds	Take a beaker filled with distilled water and add one spoonful of pepper. Papaya seeds float over water while the pepper settles down.
Ghee or Butter	Starchy matter	Take about 5 ml of the given ghee or butter in the test tube. Add about 1 ml of water to it and boil. Cool and add a drop of Iodine solution. The appearance of blue color indicates the presence of starchy matter in the sample.
	Vanaspati ghee	Take about 5 ml of the given sample of ghee or butter in the test tube. Heat the test tube gently so that the ghee or butter melts. Add a little sugar and HCl to it. Shake contents for 5 minutes. The presence of pink color in the aqueous layer is an indication of Vanaspati ghee in the sample.
Dal	Metanil yellow	Add concentrated HCl to a small quantity of dal in a little amount of water. Immediate development of pink color indicates the presence of Metanil yellow and similar color dyes.
	Lead Chromate	Shake 5 gm of dal with 5 ml of water and add a few drops of HCl. The appearance of pink color indicates the presence of lead chromate.
	Kesari Dal (Lathyrus sativus)	Add 50 ml of diluted HCl to a small quantity of dal and keep in simmering water for about 15 minutes. The pink color, if developed indicates the presence of Kesari dal.
Wheat Flour	Excessive Bran	Take a small quantity of wheat flour and sprinkle it on the water surface. Excessive bran will float on the water surface.
	Excessive sand and dirt	Take a small quantity of wheat flour and shake it with about 10 ml of Carbon Tetrachloride and allow standing. Grit and the sandy matter will collect at the bottom.
	Chalk powder	Take a small quantity of wheat flour and shake it with diluted HCl. The appearance of effervescence indicates the presence of chalk powder.
Turmeric Powder	Chalk powder or yellow soapstone	Take a small quantity of turmeric powder in a test tube containing a small quantity of water. Add a few drops of conc. Hydrochloric acid, and effervescence (give off bubble) will indicate the presence of chalk or yellow stone powder.
Common Salt	White powdered	Stir a spoonful sample of salt in a glass of water. The presence of chalk will make the solution white and other insoluble impurities will settle down.
Honey	Sugar and Water	Dip a cotton wick in pure honey when lighted with a match sticks burns. The presence of water will not allow the honey to burn. If it does it will produce a crackling sound.
Cinnamon	Cassia barks	Cinnamon barks are very thin. Cassia's barks are thick and stiff. Cinnamon barks can be rolled.
Coffee Powder	Chicory begins	Gently sprinkle the coffee powder sample on the surface of the water in a glass. The coffee floats over the water but the chicory begins to sink within a few seconds. The falling chicory powder particles leave behind them a trail of color due to a large amount of caramel they contain.
Ionized Salt	Chalk and other insoluble impurities	Stir a spoonful of a sample of salt in a glass of water. The presence of chalk will make the solution white and other insoluble impurities will settle down.

C. Methods

Spices, adulterants, and tests to find adulterants are done by Quick test for some adulterants in food, instruction manual 1&2, FSSAI [5] [11] method. The experimental work is performed in the laboratory using the mentioned physical and chemical processes (Table 1). Some simple methods can be done at home. The materials required are all spices and ingredients samples, test tubes, test tube stand, water, and dil. cotton wick, match stick, beaker, spoon, pipette with sucker, etc.

III. Results

In qualitative analysis, sugar, chili powder, Jaggery, black pepper, ghee or butter, dal, wheat flour, turmeric powder, iodized salt, common salt, honey, cinnamon, and coffee powder were analyzed for given tests and the following are the results.

TABLE II. Test Analysis, Observations, and Conclusions for Sugar and Chili Powder

SAMPLE	OBSERVATION	CONCLUSION
SUGAR Sample A Sample B	Sugar is completely dissolved.	No addition of various insoluble impurities.
Sample C Sample D Sample E	No settled chalk powder & no effervescence.	No addition of chalk powder & washing soda.
CHILLI POWDER Sample A	No colored streaks	No addition of color or sawdust
Sample B	Muddy colored	Addition of sawdust
Sample C Sample D Sample E	No colored streaks	No addition of color or sawdust
Sample F	No yellow precipitation	No addition of red lead salts Addition of brick powder
Sample G	Brick powder settled down	No addition of color
Sample H	No colored streaks	No addition of red lead salts Addition of brick powder

TABLE III. Test Analysis, Observations, and Conclusions for Salt, Turmeric Powder, and Wheat

SAMPLE	OBSERVATION	CONCLUSION
COMMON SALT Tata Captain cook I-Shakti Dandi Lakshmi Lata	No white color No impurity settled down	No addition of insoluble impurities No addition of chalk powder
TURMERIC POWDER Sample A Sample B Sample C Sample D Sample E Sample F	No effervescence	No addition of chalk & yellow soap powder
WHEAT FLOUR Sample A Sample B Sample C	No floating bran No grit, the sand matter settled down No effervescence	No addition of excessive bran No addition of excessive sand & dirt

TABLE IV. The Test Sample, Observations, and Conclusions for Jaggery, Black Paper, Ghee, Dal, Honey, Cinnamon, and Coffee Powder

SAMPLE	OBSERVATION	CONCLUSION
JAGGERY Sample A)	Pink color	Addition of Metanil yellow
Sample B) Sample C)	No pink color	No addition of Metanil yellow
BLACK PEPPER Sample A Sample B	Floating seeds	Addition of papaya seeds
GHEE/BUTTER Sample A	No blue color	No addition of starchy matter
Sample B	No pink color	No addition of Vanaspati ghee
DAL Sample A Sample B Sample C	No pink color	No addition of Metanil yellow, lead chromate & Kesari dal
HONEY Sample A Sample B	Cotton produces a cracking sound when burning	Addition of sugar & water
CINNAMON Sample A	Thick & no rolled barks	Addition of cassia barks
Sample B	Thin & rolled barks	No addition of cassia barks
COFFEE POWDER Sample A	Chicory begins to settle down	The addition of chicory begins
Sample B Sample C	No chicory begins settled down	No addition of chicory begins

Fig. 3. Tests analysis of different food ingredients a. Sugar b. Jaggery c. Dal d. Black pepper e. Salt f. Chili powder g. Wheat flour h. Coffee powder i. Cinnamon j. Honey k. Turmeric l. Ghee

IV. Discussion

For particular adulterants particular tests were performed each ingredient gave different results as per the test and different types of ingredients quality.

Five sugar samples (A, B, C, D, and E) were studied, in which all the samples did not contain insoluble impurities, chalk powder and washing soda (Table 2) (Fig. 3a). Hence tested samples are without adulterants. Kolhapur is very well known to produce the best quality sugarcane and sugar.

For chilly powder, seven samples (A, C, D, E, F, G, H,) did not contain colored streaks. Among 8 samples of chili powder only one sample, i.e. sample B (Table 2) (Fig 3. f) contains some sawdust which turns its solution muddy colored hence, concluded that there is an addition of sawdust. Three samples (F, G, and H) did not contain red lead salts. Two samples (F, G) contain little brick powder. Brick powder is having similar color and texture as chili powder has been used as a contaminant [13].The Kolhapur chilly market is one of the big market, both local and other states chili and chili powder also sells into the market. Generally in the Kolhapur region, chili powder needs to be of the best quality that's why many households are asking to make homemade chili powder mixed with many other spices traditionally rather than readymade format. Kolhapur homemade chili powder is a very unique regional item in taste and is famous for its quality.

All the branded ionized salts (Tata, Captain, cook, I-Shakti, Dandi, Lata) were tested and all the samples did not contain chalk powder and insoluble impurities (Table 3) (Fig 3.e). Hence samples are without any induced adulterant.

In turmeric samples after the addition of conc. HCl no effervescence produced (Table 3) (Fig 3.k). It confirms that no addition of chalk and yellow stone powder. Tested turmeric powders are without adulteration. Turmeric powder is a very commonly used spice in every Indian home, very good for health and enhances color. Turmeric is grown near the region of Kolhapur and considers being the best in quality.

Three samples of wheat flour (A, B, C) were tested and all the samples did not contain excessive bran, excessive sand, dirt, and chalk powder (Table 3) (Fig 3g). Hence all the samples are without adulterants. As wheat flour is also commonly used in every home for making chapatti or roti, it is a good sign that it's of very good quality as it consumes in daily meal.

Three Jaggery samples (A, B, C) were tested in which only one sample contained metanil yellow (Table 4) (Fig 3b) remaining samples are without adulterant. Most of the instances Jaggery is done by a very traditional and organic process but chemical-based process Jaggery may sometimes have this type of adulterant to enhance its appearance. Metanil Yellow is a non-permitted, toxic, chief additive adulterant is majorly used in sweets, pulses, and turmeric in India due to its colour that ranges from yellow to orange [14].

Two black pepper samples (A, B) were tested in which both samples contain papaya seeds (Table 4) (Fig 3d). Hence both of the samples contain adulterants. Black paper is not a regional agricultural spice most of it came from the southern region of India; it is not commonly used in the daily food of local people. They prefer chili powder over it but sometimes for some special food items they use it. The impulse for purposeful adulteration has usually been economic gain and involves common practices like substituting material from a completely different plant, e.g., substituting black pepper fruits (Piper nigrum) with papaya seeds (Carica papaya) based on the similarity of the external appearance of black pepper and papaya [15]. It is the most common adulterant in black pepper as the size and shape of both seeds are similar [16].

Two ghee or butter samples (A, B) were tested and both of the samples did not contain starchy matter and Vanaspati ghee (Table 4) (Fig 3l). Hence both samples did not contain adulterants. Kolhapur is also famous for its milk and milk products in Maharashtra state, hence the quality of ghee or butter consider being good.

Three samples of dal /yellow lentils (A, B, C) were tested and all three samples did not contain Metanil yellow, lead chromate, and Kesari dal (Table 4) (Fig 3c). Hence all the samples did not contain adulterants. Dal is a daily and commonly used material for many types of curry and many other dishes.

Two samples of honey (A, B) were tested and both samples contain sugar and water (Table 4) (Fig 3j). Hence tested samples are with adulterants. These samples are mostly sold by local people sometimes for increasing their quantity, they use sugar syrup and water, though it's not harmful to the health but it decreases the quality of the substance. Honey is commonly adulterated by either the addition of sugar syrups or by diluting with low cost and low quality honey [17].

Two cinnamon samples (A, B) were tested among which one sample contains cassia barks and another did not (Table 4) (Fig 3i). Hence out of the two samples, one is with adulterant and another is without adulterant. This is also a very highly used spice, most of these spices come from other regions to the city market; there are possibilities of adulteration in some items. Commercially available C.verum is often adulterated with its inferior species such as C.cassia (Chinese cinnamon) [18] the differences are the outer layer of C. cassia barks is thicker and harder, and their quills curl inward from both sides in other hand the outer layer of C. verum, is thinner and softer with quills curled in a rounded telescopic shape [19].

Three coffee powder samples (A, B, C) were tested. Only one sample contains chicory begins and another two did not contain chicory begins (Table 4) (Fig 3h). Hence out of three samples, one is with adulterant and another two are without adulterant. Tea is considered a highly favorite drink locally but there are also a quite good number of coffee lovers, the southern region of India is very famous for coffee production, and though most of the products are of good quality some may have this chicory adulterant. This tendency also found in Barcelona (Spain), Vietnam, and Cambodia that the coffee adulteration with non-coffee materials such as corn, barley, chicory,

middling wheat, brown sugar, stems or straw, among others, to reduce cost production and increase economic benefits [20].

V. Conclusion

From this study, it can be determined that most of the substances found in local markets in Kolhapur city are without adulterants & very few with adulterants. Out of eight, there was one sample of chili powder with sawdust and one with brick powder i.e. adulterated. Chili powders found in Kolhapur may be adulterated from colorants or sawdust & brick powder. One Coffee powder sample with chicory, honey samples with sugar may consider has minor adulterants. Only black paper, one Jaggery and and one cinnamon sample have a bit of worrisome adulteration but Sugar, turmeric, ghee, wheat flour, dal, etc are seen to be without any adulteration and of the best quality also two organic Jaggery samples also found without adulterants, In the case of salt samples, they are found with good content of iodine & without chalk powder and insoluble impurities as they should be. Kolhapur region people are consuming good quality food and spices. Products from local the market are of good quality which also helps preserve ethnic food purity, so it can be concluded that they are consumable and most of them are in good quality, but need to take proper precautions, to avoid consuming adulterated food. Buy products of only air tight packaging or with a properly packed way than loose. Check Food Safety Standards in India (FSSAI) or Agmark (certification mark to assure the quality of agricultural products in India).

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