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Articles

Determination of the Nutritional Values of Processed and Dried Tomatoes

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Abstract

This study was carried out to determine and compare the nutritional value of dried and processed tomatoes (Lycopersicon esculentum). Proximate analysis conducted on samples of dried tomatoes and processed tomatoes where moisture content, fat content, crude protein content, fibre content, and ash were determined. The analysis shows that, the processed tomatoes has high value composition of moisture content (12.00±0.05), crude protein content (2.60±0.01) and carbohydrate content (59.28±0.12) and it has less composition of ash content (12.00±0.02), fat content (2.0±0.06), fibre content (0.12±0.01) and energy (2.65±0.05) compared to the dried tomatoes with values of moisture content (20.00±0.13), ash content (14.00±0.08), protein content (1.68±0.02), fat content (5.00±0.12), fibre content (0.14±0.00) and energy (2.88±0.14). The study suggests the processed Lycopersicon esculentum is richer in nutrients than the dried Lycopersicon esculentum and recommended.

Keywords: Lycopersicon esculentum, proximate analysis, nutritional value and nutrients.

1. Introduction

The use of modern technologies and equipment for drying food material is escalating because it prolongs shelf life or good keeping quality and retains the bioactive nutrients (Betoret et al., 2016; Timilsena et al., 2020). These bioactive nutrients can combat nutritional related diseases and promote a state of well-being of the consumer (Timilsena et al., 2020). Tomatoes (Lycopersicon esculentum) contribute to a healthy and well-balanced diet as they are rich in dietary fibres and other nutrients (Alsuhaibani, 2018). Tomatoes are perishable crops of which deterioration starts immediately after harvest and continued till they experience spoilage due to high moisture contents and enzymatic activities (Arah et al., 2015). In Nigeria, tomato has short shelf life and considerable amounts of harvested tomatoes (over 50 %) are lost yearly due to poor storage system, poor transportation coupled with inadequate processing facilities and lack of processing enterprises (Osawaru et al., 2013). According to marketing of fresh tomato during the season is a great problem which needs to be handled (Osawaru et al., 2013). The percentage of tomatoes going into

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waste annually with no attentions paid to the loss of nutrients can lead to heavy revenue loss to farmers, decrease in market value, underutilization and to malnutrition due to food insecurity (Abimbola, 2014). Tomato as fruits vegetables and other green leafy vegetables can be dried using various methods (Sibomana et al., 2016). Dehydration does not check losses only but, related disease. Tomatoes are a highly perishable food crop in the fresh state that are excellent source of vitamin C, vitamin E, folic acid, potassium, and secondary metabolites such as b-carotene, lycopene, and phenolic compounds. Although epidemiological studies highlight the positive role of consuming fresh tomatoes, it is clear that, as tomatoes have a relatively short-life, there is need to preserve, dry or process them so that it does not lead to wastage and losses during the peak harvesting period and also this helps to provide tomatoes to commerce (Arslan, Özcan, 2011). The prevention of these wastage and losses is of great interest and value especially when there is subsequent imbalance in demand and supply so as to offer an alternative way of providing tomatoes into commerce, but however, processing and drying of tomatoes leads to loss of some antioxidant properties, change of colour, physical and structural changes such as migration of soluble solids, shrinkage, loss of volatiles and aroma (Raiola et al., 2014; Hussein et al., 2016). Tomato is a fleshy berry regarded as very popular perishable fruit as well as vegetable grown throughout the tropical and temperate regions of the world. These reasons coupled with the interest in studying different varieties of tomatoes makes it necessary for the determination of the nutritional value of tomatoes at different levels, that is, fresh, dried, and processed. delicious and stable products (Mendelová et al., 2013; Ilić et al., 2014). In some cases, processed. Industrially produced canned tomatoes are important product and subject to regular market analysis as well as trade considerations (Abdullahi et al., 2016; Campos et al., 2020). The aim of the study is to determine the nutritional value of processed and dried tomatoes.

2. Materials and methods

Collection of samples

A sample of fresh tomatoes was collected from FGGC garden, along Gombe road Bauchi, Bauchi state for its proximate composition and minerals analysis to evaluate its nutritive value to human.

Preparation of sample

Grinding; The tomatoes was cut and dried using shed drying method, and ground to powdered form by using a grinder.

Processed tomatoes were purchased and prepared for the analysis.

Proximate composition

Proximate composition: after bringing the sample to uniform size, they were analyzed for moisture, protein, fat, fiber by the methods AOAC (2003).

Determination of moisture

Moisture was determined by oven drying method. 5g of well-mixed sample was accurately weighed in clean, dried crucible (W_1). The crucible was allowed in an oven at 100-105^0 C for 6-12 h until a constant weight was obtained. Then the crucible was placed in the desiccator for 30 min to cool. After cooling it was weighted again (W_2). The percent moisture was calculated.

Determination of ash

For the determination of ash, clean empty crucible was placed in a muffle furnace at 600^{0}C for an hour, cooled in desiccator and then weight of empty crucible was noted (W_1). One gram of each sample was taken in crucible (W_1). The sample was ignited over a burner with the help of blowpipe, until it is charred. Then the crucible was placed in muffle at 550^{0}C for 2-4 hours. The appearance of grey white ash indicates complete oxidation of all organic matter in the sample. After aching furnace switch off. The crucible was cooled was weighted (W3).

Determination of crude proteins

Protein in the sample was determined by Kjeldahl method. 0.5-1.0g of dried sample was taken in diagram flask. Add 10-15 ml of concentrated H_2SO_4 $CuSO_4$ (8: 1). The flask was swirled in order to mix the contents thoroughly then placed in heater to start digestion till the mixture become clear (blue green in color). It needs 2 hrs to complete. The digest was cooled and transferred to 100 ml volumetric flask and volume was made up to mark by the addition of distilled water. Distillation of the digest was performed in Markam Still Distillation Apparatus (Khalil,

Manan, 1990). Ten millilitres of Digest was introduced in the distillation tube then 10 ml of 0.5 N NaOH was gradually added through the same way Distillation was continued for at least 10 min and NH_3 produced was collected as NH_4OH in a conical flask containing 20 mi of 4 % boric acid solution with few drop of modified methyl red indicator. During distillation yellowish color appears due to NH_4OH. The distillate was then titrated against standard 0.1M HCL solution till the appearance of pink color. A blank was also run through all steps as above. Percent crude protein content of the sample was calculated.

Determination of crude fat

Dry extraction method of determination was implied. It consisted of extracting dry sample with some organic solvent, since all the fat materials e.g. fat, phospholipids, sterols, fatty acids, carotenoids, pigment, chlorophyll etc. are extracted together therefore, the result are frequently referred to as crude fat. Fat was determined by ether extract method using Soxhlet apparatus. Approximately 1 g of moisture free sample was wrapped in filter paper, placed in fat free thimble and then introduced in the extraction tube. Weighted cleaned and dried the receiving beaker was filled with petroleum ether and filled into apparatus. Turned on water and heater to start extraction. After 4-6 siphoning allow ether to evaporate and disconnect beaker before last siphoning. Transferred extract into clean glass dish with ether washing and evaporated ether on water bath. Then placed the dish in an oven at 105_0C hrs and cooled it in a desiccator. The percent crude fat was calculated.

Determination of crude fibre

A moisture free and ether extracted sample crude fibre made of cellulose was first digested with dilute H_2SO_4 and then with dilute KOH solution. The undigested residue collected after digestion was ignited and loss in weight after ignition was registered as crude fibre.

0.153 g sample weighed (W_0) was weighted and transferred to porous crucible. Then place the crucible into Dosi- fibre unit and kept the valve in “OFF” position.

150 ml of preheated H_2SO_4 solution and some drops of foam-suppressor were added to each column. The heating elements (power at 90 %) opened of the cooling circuit turned on until it started boiling, the power was reduced to 30 % and left for 30 mins. Valves were opened for drainage of acid and rinsed with distilled water thrice to completely ensure the removal of acid from sample. The same procedure was used for alkali digestion by using KOH instead of H_4SO_4. Dried the sample in an oven at 150^0C for 1 h. The sample was allowed to cool in a desiccator and weighted (W1). The sample was kept in the crucible in muffle furnace at 55^0C for 3-4 hrs. The sample was cooled in desiccator and weighted again (W_2) Calculations were done.

Determination of carbohydrate

Carbohydrate was determined by adding the sum of moisture, ashing, protein, fat and fibre of the sample in %, the remaining sum is the percentage of carbohydrate content.

Energy calculation

The percent calories in selected samples were calculated by multiplying the percentage of crude protein and carbohydrate with 4 and crude fat with 9. The values were then converted to calories per 100 gm of the sample.

3. Results

Table 1. Results of the nutrient and mineral contents of dried and processed tomatoes in mg/100 g

Parameters	Dried tomatoes(mg/100g)	Processed tomatoes(mg/100g)
Moisture	20	24
Ash	14	12
Protein	1.68	2.6
Fat	5.0	2.0

Fiber	0.14	0.12
Carbohydrate	59.18	59.28
Energy	2.88	2.65

3. Discussion

Proximate composition

The moisture content of the processed tomatoes is higher than that of the dried tomatoes and this indicates that its shelf life will be shorter since high moisture content is associated with increase in microbial activities, which is in agreement with the reports of Arslan & Özcan (2011). The dehydration of the tomatoes plays an important role on the microorganisms. According to Abdullahi et al. (2020) the removal of water is a method of controlling microbial growth, since they require water to develop their metabolic activities as reported in this study. High moisture content also promotes susceptibility to enzymes activity in a given tomatoes sample (Timilsena et al., 2020), this is also corroborated by current study.

With regard to ash content, the processed tomatoes was found to have the lowest ash content of 12 mg/100 g which is thought to result in high moisture content of the plant. According to the climatic conditions and the mountainous influences these allowed the retention of heat and subsequent diffraction by the plastic contained thus, increasing the thermal peak temperature. Looking at the percentage composition of crude protein, the processed tomatoes were found to have the highest crude protein (2.68) and differ significantly with the dried tomatoes. The dried tomato sample was found to have the highest fat content than the processed tomatoes, several factors might result to such differences. The difference of processing mechanism involved in the processes of preservation might have a different effect on the fat content. Also, geographical differences may also be a contributing factor for the differences as equally outlined by Hussein, Sanusi & Filli (2016). The crude fibre content of processed tomatoes is significantly lower than the dried tomatoes, this could be because the high water content contributes to the low dry matter which contains the crude fiber. With regard to carbohydrate and energy content, the dried tomatoes were found to have the lowest carbohydrate content of 59.18 while the processed tomatoes are slightly high with a value of 59.28. The energy content of dried tomatoes was 2.88 while the energy content of processed tomatoes was 2.65.

4. Conclusion

The starting point for retaining the tomatoes excellent nutritional properties during drying and processing into different products are the raw material. The quality of the vegetable is therefore, a primary key factor determining the nutritional quality of the end product. However, the processing of this material can be a major usually negative influence especially where incorrect sub-optimal procedures are applied. Hence great attention should also be given to understanding and then avoiding or minimizing the detrimental effects of these technological processing methods. The exact level of loss or even gain of antioxidants differs widely according to the type of treatment, the conditions of the process applied and also the source history of the tomatoes used.

5. Recommendations

1. Processed foods are often regarded as less nutritious than the dried foods. This is not always true for tomatoes as this research shows that processed tomatoes have high content of protein and carbohydrate than the dried tomatoes.

2. Proper drying method should be used because drying of tomatoes with direct sunlight makes the tomatoes to lose some of its essential nutrients, therefore shade drying or oven drying method should be employed.

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Assessment of Breast Bacterial Infection in Women: A Review

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Abstract

Many studies reported that the bacteria are one of the causes of infections occurs in women's breast, mastitis, and the common bacteria that cause breast infections are *S. aureus* and *S. epidemidis*. However, there is a rare/or uncommon bacteria that cause infection including Pseudomonas species, Salmonella species, Porteus mirabilis, *Klebsiella pneumonia,* Streptococcus group A/or *B, Brucella, E. coli* and Mycobacterium species.

The mastitis affects both lactation and non-lactation women. Most bacteria contain virulence factors that help to penetrate the invaded tissue and secreted enzymes that degraded skin/tissue.

In some cases, there is a possibility to increase the severity of the infection and led to cancer. We recommended the women they notice any abnormal change or feeling pain in the breast to visit a specialist to check their breast for any infection.

Keywords: Breast infection, *S. aureus*, *S. epidemidis*, other bacteria.

1. Introduction

Breast infection is common in breastfeeding women (lactating women) which occurs in approximately 20 % of breastfeeding women and may lead to the stop the breastfeeding. It is ranged from mild superficial mastitis to deep abscesses. This infection also occurs in non-breastfeeding women, however its uncommon (Abdel Hadi, Bukharie, 2005; Cullinane et al., 2015).

The majority of cases occur in the first 6 weeks of post-partum when bacteria enter milk ducts from baby's mouth through a crack in the nipple but also can occur at any time during lactation or non-lactation (AL-awady et al., 2019).

The infection affects the fatty tissue in the breast, cause swelling, lumps, and pain. Most breast infections are due to breastfeeding or clogged milk ducts, and a small percentage is associated with rare kinds of breast cancer. A chronic inflammation of the breast, affecting mainly women of reproductive age, is commonly associated with duct ectasia, and breast abscess (Ducatman, Wang, 2009) and the breast abscess occurs generally in women with infectious mastitis (Abdul-Razaq et al., 2014). Traditionally, *Staphylococcus aureus* has been considered the most common etiological agent of mastitis and is often isolated in cases of infective mastitis and breast abscesses. Many other opportunistic pathogens are known to cause mastitis including, *P. aeruginosa, E. coli, S. agalactiae and K. pneumoniae* (Dudhatra et al., 2010).

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2. Results and discussion

Staphylococcus aureus

Amir et al. (2006) found that women with mastitis were more likely to have *S. aureus* present in breast milk than women in the control group. In another study by Cullinane et al., (2015) who investigates the presence of *S. aureus* in women with mastitis, they found there was a positive correlation (Cullinane et al., 2015). Also, the study obtained by Kataria et al., (2013) shows that *S. aureus* is a common cause of abscess in the breast. This bacteria has many virulence factors include coagulase, collagenase, exfoliate toxin, hemolysins, hyaluronidase, leucocidins, lipase, nuclease and staphylo-kinase, which can invade and colonize host tissue and evasion of the host immune defence mechanisms (Tuchscherr et al., 2019).

Fifty percent of S. aureus that causes breast abscess are penicillin-sensitive and there is an increasing range of methicillin-resistant *Staphylococcus aureus* (MRSA) breast abscess which is susceptible to antimicrobials like trimethoprim/sulfamethoxazole, fluoroquinolones and clindamycin (Ramakrishnan et al., 2017).

Abdel Hadi and Bukhari (2005) collected samples from 6314 patients with breast problems and find that 179 (3.5 %) had a breast infection. Of these infected clinical conditions were found in 26 patients (60 %) in non-lactating namely granulomatous mastitis 13(50 %), duct ectasia 4(15.3 %), pregnancy 3(11.5 %), diabetes 3(11.5 %), fat-necrosis 1(3.8 %) and breast cancer 2(7.6 %).

The pattern of culture results was different in the lactating and non-lactating from differing causative organisms, but S. aureus was the communal organism in patients. Other organisms as *K. pneumonae*, Streptococcus group-B, *Peptococcus Magnus, E. cloacae*, Methicillin-resistant *S. aureus* and *M. tuberculosis* occurring in non-lactating only (AbdelHadi, Bukharie, 2005).

In a study conducted by AL-awady et al. (2019), they have used sau gene which is a specific gene for detection of S. aurous to confirm the diagnosis, found out of 100 samples only 50 samples contain this gene. In addition, specific primers (hla, hld, hlb, hlg) were used to amplify the four hemolysins virulence genes in all *S. aureus* isolates using PCR. The result demonstrated that 24 (54.5 %) of *S. aureus* have hld gene, followed by hla gene which constituted 20 (45.4 %), then hld gene 16 (36.3 %) followed by hlb gene which constituted 14 (32 %) from all *S. aureus* isolates. Oliverira et al. (2013) found that beta-hemolysins toxin is produced in large quantities in *S. aureus* strain isolated from mastitis and human skin infection. Beta-hemolysins is cytotoxic towards human keratinocytes, Polymorph nuclear leukocyte, monocyte, T-lymphocyte, inhibit interleukin 8 expressions by endothelial cell, and induce biofilm formation in *S. aureus*.

Bengualid et al. (2008), recorded that the most common pathogen in non-lactating breast abscesses was *S. aureus* (32 %) and 39 % of abscesses were caused by poly-microbial; while 7 % were an-aerobic pathogens. These cases were including 13 cases of nipple piercing infections and 4 cases were coagulase-negative staphylococci, four cases were mycobacteria, and others an-aerobes, group A streptococcus, Gordonia terrae and group B streptococcus.

Co.N.S species, Pseudomonas species & other bacteria

Coagulase-negative staphylococci (Co.N.S) now consider a communal pathogen that can cause mastitis in the world such as *S. epidermidis, S. chromogenes, S.simulants, S. xylosus, S. hyicus, and S. haemolyticus* (Sakwinska, Bosco, 2019). Because of their ability to biofilm formation and colonization on any surfaces, in addition to virulence factor of biofilm, they have the methicillin resistance genes that make the treatment of its infection so difficult (Namvar et al., 2014). Pseudomonas species is an opportunistic nosocomial pathogen contains many virulence factors such as LasI and LasB. These factors increase the invasiveness of pathogen and their presence is necessary for the development of infection of P. aeruginosa (Al-Wrafy et al., 2016). They are also responsible for biofilm formation and antibiotic resistance which leads to increase the difficulty of treatment of this infection (Moghaddam et al., 2014).

Nezar et al. (2020) reported that the highest bacteria to cause acute mastitis in non-lactating women were *S. epidermidis*. They have collected fifty-six samples from nipple discharge out of them fifty-one samples give positive culture for bacteria, out of these fifty-one isolates they found 40 isolates were *S. epidermidis* (78.43 %), 3 isolates were *P. stutzeri* (5.88 %), 3 isolates were *P. oryzihabitans* (5.88 %), one isolate was *P. aeruginosa* (1.96 %), one isolate was *K. pneumoniae* (1.96 %), 2 isolates were *S. viridans* (3.92 %), and one isolate was *Acinetobacter baumannii* (1.96 %). The result of antibiotics revealed that *S. epidermidis* show high sensitivity to imipenem then tobramycin, gentamycin, and amikacin, respectively. Pseudomonas species are more sensitive

to imipenem, azithromycin, ciprofloxacin, tobramycin, amikacin, tetracycline, gentamycin, and piperacillin respectively. In addition, by using PCR found 4/40, isolates of *S. epidemidis* have icaA gene, all isolates of the *S. epidermidis* have icaD gene, sei gene enterotoxin found in 6/40 of isolates and mecA gene found in 38/40 of S. epidermidis isolates. In Pseudomonas species, the virulence factors lasR, gyrB and lasI genes were positive for all isolates.

Baqer and Mahdi (2019) identify seventy-four Co.N.S isolates, 56 mastitis & 18 healthy women. The most frequent bacterial isolates in lactating women, mastitis and healthy were *S. epidermidis*. The highest resistance percentages were found to ampicillin, erythromycin, trimethoprime/sulphamethoxazole, methicillin, carbenicillin, gentamicin, cefotaxime, temocillin, ceftazidim, cefepime, ciprofloxacin, ampicillin/sulbactam, cefoxitin, nalidixic acid and tobramycin, respectively. A study by Aldeen and Méshkoor (2017), recorded that *Staphylococcus epidermidis* was the most common species in breast infection followed by *Staphylococcus haemolyticus* and *Staphylococcus hominis*. They noticed that most of the Co.N.S isolates were resistant to penicillin G, Cefoxitin, oxacillin. All isolates appeared to have the mecA gene. In another study by Delgado et al. (2009), they reported the presence of staphylococci in twenty-seven of the thirty samples provided by women with locational mastitis. They collected a total of 270 isolates obtained from the Baird Parker agar plates, 10 from each lactating-woman, 200 isolates were identified as *S. epidermidis*, 35 isolates were S. aureus, 16 isolates were *S. pasteuri*, 11 isolates were *S. warneri* and 8 isolates were *S. hominis*. In a study conducted by Shnawa and Al-Bermani (2007) reported from sixty women with lactating mastitis and twenty normal lactating women as control milk samples 16 samples (26.6 %) were *S. aureus* isolates, *P. aeruginosa* 13 samples (21 %), *K. pneumonia* 10 samples (16 %), *S. epidermidis* 9 samples (15 %), *E. coli* 2 samples (3.3 %), *S. viridans* 1 sample (1.6 %). A Study by Al-Haddad et al. (2018) showed that Salmonella species, *P. aeruginosa*, *E. coli*, *P. mirabilis, K. pneumonia, Kocuria kristinae* and Citrobacter species are most causes of infection. Recently Chen et al. (2018) revealed that Salmonella species, *E. coli* and few by *P. mirabilis* result in different infections and no cases reported with re-current breast abscesses caused by *Kocuria kristinae*. Different bilateral breast abscess was caused by multiple organisms in immune-competent non-lactating women. Brucellar breast abscess is a rare entity, however, Erdem et al. (2006) and Ibis et al. (2009) were isolated Brucella species from breast abscess in old women. Another uncommon pathogen to cause mastitis is *Actinomyces europaeus*, which were isolated by Silva et al. (2011) from primary breast abscess in a post-menopausal woman.

Mycobacterium tuberculosis (TB)

In a study by Jairajpuri et al. (2018) reported that breast TB associated with both pulmonary and extrapulmonary manifestations which important to diagnose the disease as malignancy or present as an inflammatory lump/or abscess. Malhotra et al. (2015) were reported primary tubercular abscess in young non-lactating women represented by painful lump and non-specific symptoms. They use ultra-sound for breast, fine needle aspiration, cytology and Ziehl-Neelson staining confirmed on culture to diagnose tuberculosis. TB is a major public health problem in a developing country, for example in India accounting for 1/4 of the global incident TB cases annually.

Mycobacterium fortuitum

Mycobacterium fortuitum infection has been estimated to be between four and six cases per 1 million people. Abbass et al. (2014) recorded that *M. fortuitum* & Nocardia species form breast abscess after nipple piercing, however, this infection appears to be uncommon. At the time of writing this review, there were no-standard recommendations to controller treatment of breast abscess. The treatment of this condition is similar to the treatment of *M. fortuitum* implant infection. Betal and MacNeill (2011) recommended removal of the piercing as an initial measure, no standard duration of therapy has been described, treatment might last six months or more, and they used imipenem, doxycycline, sulfonamides, linezolid, fluoroquinolones, clarithromycin and cefoxitin, as first-line antibiotic therapy for *M. fortuitum* infection. Similarly, Bengualid et al. (2008) recorded two cases of infection by *M. fortuitum*.

Salmonella Species

Murugesan et al. (2016) isolate *S. typhi* in non-lactating women in ages between 23 and 45 years in immune-competent. The sensitivity test revealed that *S. typhi* sensitive to amikacin, ampicilin-sulbactam, ceftazidime, cefepime, pipataz and imipenam. In a recently published study by Al-Benwan et al. (2010), *S. enterica* serotype Poona was isolated from abscess of the breast with

erythema-nodosum. The pathogenesis of abscess formation in *S. typhi* infection is unknown. Bilateral breast abscesses due to *S. typhi* is a rare condition (Singh et al., 2009). Rizzo et al. (2009) and Singh et al. (2011) isolated *S. enterica* serotype Typhi and S. typhi from non-lactating women with breast abscess, respectively. Brncic et al. (2012) isolated *S. enterica* serotype Enteritidis from old women with breast abscess and the infection was treated with a combination of surgical and antibiotic treatment. Likewise, Baran et al. (2016) isolated *S. enterica* serotype Typhimurium from breast abscess.

Age of patients with breast abscess

A breast abscess is an infection with pus cells which commonly affects women with age ranging from 18-50 years. It has been classified as a lactation & non-lactation infection (Dixon, 1994). Shnawa and Al-Bermani (2007) recorded that the domination mastitis age in lactating women was 15-45 years old. A study by Nezar et al. (2020) reported that the high incidence of infection in non-lactating women was among ages range (21-50) years and less incidence was in age under 21 and above 50 years, however, the incidence of infection is high in age 40-45 year. In another study by Al-Sarraf (2010), he recorded that the majority of breast disease was among ages of 21-50 years. The mean age of carcinoma was 41.5 years. In his study which including 53 patients had bacterial mastitis of these patients, 50 were lactating women, 13 (17.1 %) patients have carcinoma of the breast, 6 (7.9 %) patients with fibro-adenosis 2 (2.6 %) patients have fibro-adenoma, one patient has hydatid cyst in breast and one (1.3 %) patients with galactocele. Similarly, the study by Chen Chen et al. (2018) reported that 75 % of women were at the 2nd and 8th postpartum weeks at the time of diagnosis, 80.5 % patients were primi-parae while 19.5 % were multi-parae, 86.1 % of women have a history of milk stasis of the affected breast within three days before symptoms onset, 22.2 % of women have inverted nipples, while 11.1 % have damaged nipples with a mean duration of symptoms is 9.4 ± 6.2 days. 91.7 % of women recorded symptoms such as redness and swelling of the affected breast, 19.5 % of women ran a sustained fever at 24 hours and ≥ 38.5°C.

3. Conclusion

We concluded from previous studies that bacteria have an important role in mastitis, and of them, *Staphylococcus aureus* and *Staphylococcus epidermidis* are the most common bacteria that cause infection. Additionally, mastitis infections occur in breastfeeding and non-breastfeeding women. Other bacteria that cause infection but rare/or uncommon are *Pseudomonas* spp, *Salmonella* spp, *Porteus mirabilis, Klebsiella pneumonia*, *Streptococcus* group A/or B, *Brucella, E. coli* and *Mycobacterium* species. The mastitis infections occur in breastfeeding and non-breastfeeding women. Education on optimal placing and attachment are leading to a decrease in nipple injury and incidence of mastitis among women. Also, the combination of medical and surgical management is helps in some cases when supported by a microbiological culture and sensitivity report.

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Reviews

A Review about Lavender Importance

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Abstract

This present review aimed to focus on the lavender oil which used in alternative medicine for many centuries. Because of Lavandula species are highly aromatic plants and produce essential oils wich composition varies within the same species and among different species. The oil contains hundreds of chemical compounds and the major compounds such as linalool, linalyl acetate, β-ocimene, terpinen-4-ol, lavandulyl acetate and more others act on many chronic and degenerative illnesses, such as cancer autoimmune disorders, cardiovascular, rheumatoid arthritis, and neurodegenerative diseases. The secondary metabolites found in this plant have high antioxidant activity, important antimicrobial agents, several microorganisms, have activity against many fungal species, antiproliferative activity, anti-inflammatory activity, pain relief effect, wound healing effect and recognized as an antiseptic and insecticide agent. Also used as an ingredient in bath salts and washing agents as well as commercial cosmetic products: hair shampoo, cosmetic and bath products.

Keywords: essential oil, antimicrobial, aromatherapy, *Lavandula*, therapeutic.

1. Introduction

Lavender is one of the important members of the Lamiaceae family. This species are widely distributed in the Mediterranean region and cultivated in Italy, France, and Spain. The *Lavandula augustifolia* Mill. specie is well known as important aromatic and medicinal herb that is used in traditional and folk medicines for its importance in the treatment of several gastrointestinal, rheumatic and nervous disorders (Hajhashemi et al., 2003). Several studies showed that *Lavandula augustifolia* essential oil (EO) has antinociceptive, immunomodulatory and anti-inflammatory properties (Peana et al., 2002). Ebn-e-sina and Razi also prescribed lavender for treatment of epilepsy and migraine attacks. Furthermore, lavender is considered beneficial in treatment of pain and tumor (Gorji, 2003). Although the main active ingredients of these oils are monoterpenes (linalool, linalyl acetate, lavandulol, geraniol, bornyl acetate, borneol, terpineol, and eucalyptol or lavandulyl acetate), they may have different anti-bacterial and anti-fungal activities, depending on their chemical composition (Glinka, Glinka, 2008).

A good anti-microbial properties of lavender essential oil is achieved by high and almost equal content of linalool and linalyl acetate (a ratio above one) (Glinka, Glinka, 2008). Most commonly lavender is recommended for oral administration. However, it is also being employed in

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aromatherapy (inhalation of lavender) (Sasannejad et al., 2012), aromatherapy massage, dripping oil and bathing (Xu et al., 2008). In this paper we review the therapeutical effects of lavender oil components that have valuable effects like antibacterial, antifungal, carminative (smooth muscle relaxing), sedative, antidepressive and effective for burns and insect bites (Morris, 2002).

2. Discussion and results

Classification of lavender

There are several types of genus *Lavandula* , including*: L. angustifolia,* true lavender, English lavender, *L. dentate*, French lavender, *L. latifolia,* spike lavender and *L. stoechas,* French or Spanish lavender; hybrids of lavender (Renaud et al., 2001).

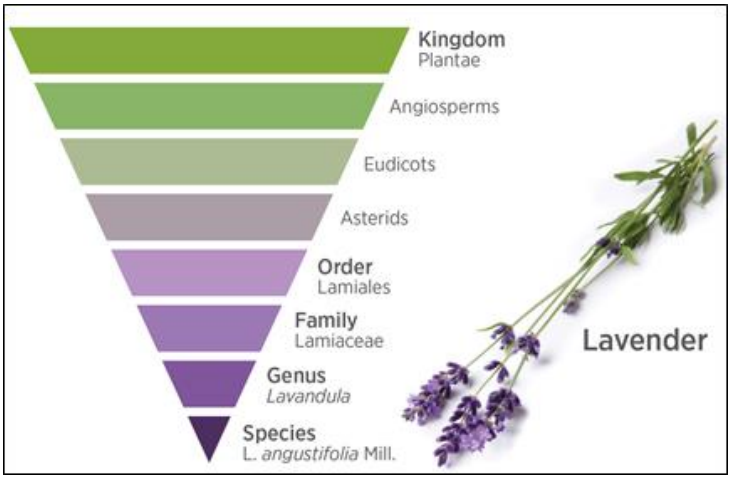

Fig. 1. The classification of Lavender (Growth, 2020)

Origin and distribution

The name “lavender” belongs to ancient times and comes from the Latin word lavare, which means washing and bathing. Most lavender originates in the Mediterranean Sea, in calcareous, rocky areas; also grow in many other countries of the world) (Smigielski et al., 2009).

Description of the plant

Lavender grows to about 40–60 cm with regular compact clumps. The upper part of stem is green, while the lower part is woody. It has lanceolate leaves with curled edges and fibrous branched root System. The silver-green leaves are covered with tomentum that protects them from wind, strong sunshine, and excessive waterloss. Pale violet flowers arranged in circles (3–5 flowers per circle), although, varieties with white flowers (Alba and Nana Alba) and pink flowers (Rosea) have also been bred (Góra, Lis, 2012).

Fig. 2. The hole plant (*Lavandula angustifolia*)

Lavandula angustifolia grows on fertile and well-drained lime soils.Lavender shrubs are regularly pruned in order to stimulate plant growth and to promote flowering. The flowering period take time from July to August.

Harvesting should be done in dry, sunny days. Flowers should be collected before opening, dried in bundles in shaded and well-ventilated places.The portions used for herbal purposes are flowers or flowering aerial parts, while the parts used for essential oil production consists of fresh or dried tops of flowering plants (Góra, Lis, 2012).

Composition-essential oil of lavender

The essential oil of lavender has been used in alternative medicine for many centuries. All Lavandula species and hybrids are highly aromatic plants; whose glands, found on flowers and leaves, produce a complex variety of essential oils. Essential oil is present in amounts from 2 % to 3 %. It is obtained by steam distillation or hydrodistillation; the oil is yellow and has strong floral-herbal lavender scent with a delicate hint of fruit and wood (Smigielski et al., 2009).

The essential oil composition varies within the same species and among different species. This is due to many factors such as genotype, extraction methods, growing, location, and climatic conditions (Śmigielski et al., 2013). The oil contains hundreds of chemical compounds and the major compounds consisted of oxygenated monoterpenes while smaller amounts of monoterpene esters are present (Hashim, Shawkat 2016). The dominant compounds reported from different countries were linalool (27.3–42.2 %), linalyl acetate (27.2–46.6 %), (Z)-β-ocimene (0.2–11.6 %), terpinen-4-ol (0.70–4.6 %), lavandulyl acetate (0.50–4.8 %), β-caryophyllene (1.8–5.1 %), (E)-β-ocimene (0.30–3.8 %), α-terpineol (0.30–2.0 %) and 1,8-cineole (0.10–1.2 %), Figure 3 (Śmigielski et al., 2013).

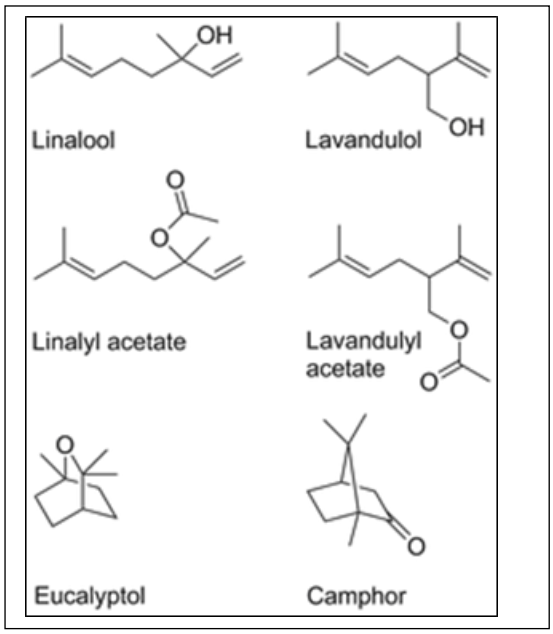

Fig. 3. Structure of major chemical components of *Lavandula angustifolia*

Lavender extraction procedures

Different extraction methods have been applied for extraction of volatile compounds of *L. angustifolia* which include hydrodistillation, supercritical CO2 (SCE) and ultrasound-assisted extractions. Extraction of lavender flavoring components by the supercritical CO2 offered new challenges for isolation (Da et al., 2009).

The volatile components extracted by supercritical CO2 contained high percentages of valuable compounds such as linalool (43 %), linalyl acetate (23 %), camphor (8 %) and borneol (7 %) were detected in the lavender volatile components extracted by supercritical CO2 (Danh et al., 2012) that can be used in the food and pharmaceutical industries.

Benefits and uses of the lavender plant:

Antioxidant activity of *Lavandula* spp. Plants

Many chronic and degenerative illnesses, such as cancer autoimmune disorders, cardiovascular, rheumatoid arthritis, and neurodegenerative diseases are triggered by oxidative stress. The secondary metabolites found in *Lavandula* spp. are flavonoids and phenolic acids, which have high antioxidant activity. Essential oil of *Lavandula* have antioxidant activity since they include thymol, linalool, limonene, fenchone, camphor, camphene, β-caryophyllene, 1,8-cineol and trans-α-necrodyl acetate (Carrasco et al., 2016). There are several studies about positive effects of Lavandula spp. on health that are related to antioxidant activity. In vitro studies showed that the lipoxygenase inhibitory and hyaluronidase inhibition effect and antibacterial activity of *Lavandula* spp. EO are related to its antioxidant activity (Carrasco et al., 2016). The antioxidant activity of *Lavandula* spp. play a critical role in the development of both treatment and pre-treatment strategies of most neurological disorders that are related to accumulation of oxidative stress in brain cells (Rabiei et al., 2014). In addition to that, anti-cholinesterase and anti-epileptogenic activities of Lavandula spp. are also related to the antioxidant activity of *Lavandula* spp. (Rahmati et al., 2013).

Antibacterial activity

Essential oils from plants have been demonstrated as important antimicrobial agents against several microorganisms (Varona et al., 2013). The antimicrobial activities of these oils are different in relation to their chemical composition (Mutlu-Ingok, Karbancioglu-Guler 2017). Lavender oils have demonstrated an antibacterial activity against *Citrobacter freundii, Enterobacter aerogenes, E. coli, Propionibacterium acnes, Proteus vulgaris, Pseudomonas aeruginosa, Shigella sonnei, S. aureus, Streptococcus pyogenes* (Sasaki et al., 2015).

Antifungal activity

Many studies reported that *Lavandula* oils have activity against many fungal species, including *C. albicans, Aspergillus* strains*, and Cryptococcus neoformans. L. angustifolia* oils activity has been reported against *C. albicans* commonly associated with yeast infections (de Rapper et al., 2016). Lavender oil reduced the severity of Candida infections (Minooeianhaghighi et al., 2017).

Antiparasitic activity

Lavender has activity against the parasites *Schistosoma mansoni* and *Leishmania major* (Shokri et al., 2017). The EO from *L. angustifolia* leaves dominated by borneol, epi-α-muurolol, α-bisabolol, precocene I, and 1, 8-cineole, exerted an effects on adult *S. mansoni* and egg development (Mantovani et al., 2013). *L. angustifolia* EO and its nano-emulsion showed anti-leishmanial activity on promastigotes of *Leishmania major* (Shokri et al., 2017).

Antiproliferative activity

Three new aryl-benzofurans were isolated from the whole plant of *L. angustifolia*; these isolated compounds showed inhibitory activities against human leukemia, human alveolar basal epithelial carcinoma, human neuroblastoma, and human prostate cancerand MCF7 human breast adenocarcinoma cell lines (Tang et al., 2017).

Anti-inflammatory activity

Lavandula spp. is frequently used as remedies for various inflammatory diseases treatment (Giovannini et al., 2016). *L. stoechas* EO has shown anti-inflammatory properties due to its important volatile composition (Carrasco et al., 2015). *L. multifida* terpenoids have been showed an anti-inflammatory activity comparable to that of indomethacin (Sosa et al., 2005).

Pain relief effect

Lavender has been demonstrated as a plant with sedative, calming, analgesic, and antispasmodic healing properties and effective in elevating moderate depression (Gaware et al., 2013).

Furthermore, *Lavandula* EOs have been used in the aromatherapy treatments to relief pain. EOs are absorbed or inhaled and thus, limbic system is affected. As a result, several variations in

the body could benoticed such as stimulation of physiological responses of the nervous, endocrine, or immune systems, affecting heart rate, blood pressure, breathing, brain wave activity, and the release of various hormones (Gaware et al., 2013). Seyyed-Rasooli et al. have reported that using of lavender oil in inhalation aromatherapy and aromatherapy massage could reduce the anxiety and pain of burn patients (Seyyed-Rasooli et al., 2016). Furthermore, lavender oil was found as an effective on the reduction of menstrual pain depending on self-aromatherapy massage of the abdomen (Kim et al., 2011).

Wound healing effect

A wound-healing effect of lavender is one of a promising treatment for skin disorders. It has been reported that application of lavender ointment effectively stimulated wound contraction. This activity was due to its compounds such as linalool and linalyl acetate (Djemaa et al., 2016). Furthermore, a report by Vakilian et al. have showed that lavender oil could be used as an alternative to povidone-iodine which is an antiseptic and used for surgical and skin wounds (Vakilian et al., 2014). Also, it has been reported that there is no side effects associated with lavender oil treatment.

Side effects of lavender oil

The following are common side effects that may appear in some people after using the oil:

An allergic reaction or sensitivity to the sun, when applying lavender oil to the skin.

Stimulating breast growth in boys before using products that contain lavender oil frequently, as some studies have indicated that it may enhance the estrogen hormone responsible for the emergence of female characteristics and breast growth, as it may prevent the androgen that means properties and prevents breast growth (Gilani et al., 2000).

3. Conclusion

From what has been presented previous about lavender, we can conclude that it is a magical herb because its fragrant aromatic oil has wide and multiple benefits, for example, but not limited to: its importance in treating many gastrointestinal, rheumatic and nervous disorders. Lavender essential oil has been used as antioxidant, antibacterial, antifungal, anti-inflammatory and for pain relief effect and it is one of a promising treatment for skin disorder.

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