CAMEL MILK

Camel milk is generally opaque white (Dilanyan, 1959; Yagil and Etzoin, 1980). Fresh camel milk has pH between 6.5 - 6.7 and specific gravity of cow, sheep or buffalo milk is less than camel milk (Shalash 1979). The fat of camel milk mainly consists of polyunsaturated fatty acids which are completely homogenized and gives smooth white appearance to the milk. Camel milk contains 4.8% lactose which can be completely metabolized by persons suffering from lactose intolerance (Haana, 2001). Acidity of camel milk increases when left to stand. The water content is the most important factor in camel milk. The amount and quality of feed eaten and water drunk directly affects the taste and quality of milk which results in fluctuations in fat, protein and salt (Yagil and Etzion, 1980). Grazing on *Atriplex halimus* gives a salty taste to the milk, and grazing on *Schouwia purpurea* gives a cabbage smell to the milk (Gast *et al.*, 1969).

The milk protein lactoferrin has some anti-viral and anti-bacterial properties and it is present in large quantities in camel milk (ten times higher than in cow milk). Camel milk protein has the ability of preventing and curing food allergies because it does not contain beta-lactoglobulin (Merin *et al.*, 2001) and contains different beta casein (Beg *et al.*, 1986) as compared to cow milk. These two components in cow milk are responsible for causing allergies. Fermented camel milk contains lactic acid bacteria in high numbers, which have been shown to be effective against pathogens including *Bacillus*, *Staphylococcus*, *Salmonella* and *Escherichia*. The content of vitamin C in Camel milk is generally double that in cow’s milk. Camel milk is a good option for children suffering from milk allergies because composition of camel milk is quite different from the milk of ruminates (Yagil, 1982; Yagil and Crevald, 2000).

The immunoglobulin (Igs) and protective proteins in camel milk contribute to camel milk’s incredible infection fighting and eradication capacity. Camel Igs (which exist in the milk) are able to penetrate into tissues and cells that human Igs are unable to. Therefore, they are able to get into the kidney or inside a cell, where they are also able to completely neutralize the enzyme activity of an infectious agent such as a bacteria or virus.
Camel milk has an apparent positive effect on breast cancer. It is also used in the treatment of Autism (Shabo and Yagil et al., 2005) and milk allergies (Shabo et al., 2005).

Camel milk also contains:- (Werney, 2003).

- **Lacto peroxides** that suppress gram negative bacteria and are most effective in raw milk.
- **PGRP- Peptidoglycan Recognition Protein** that broadens the anti-microbial activity and stimulates the immune system.
- **N’-acetyl-glucosaminidase (NAGase)** antiviral activity.
- **Lysozyme** which inhibits the growth of bacteria, and has effective influence on the storage of camel milk.

Camel milk contains a protein that is similar to insulin (Agarwal et al., 2007). It also has an inflammation inhibiting effect on the β cells of the pancreas. The insulin like protein and the inflammation inhibiting properties can explain the results of animal experimental, epidemiological and clinical research which show that camel milk is good for people with diabetes (Agarwal et al., 2006).

**CLASSIFICATION**

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>Proteobacteria</td>
</tr>
<tr>
<td>Class</td>
<td>Gamma Proteobacteria</td>
</tr>
<tr>
<td>Order</td>
<td>Enterobacteriales</td>
</tr>
<tr>
<td>Family</td>
<td>Enterobacteriaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>Cronobacter</td>
</tr>
<tr>
<td>Species</td>
<td>sakazakii</td>
</tr>
</tbody>
</table>
Binomial name

*Cronobacter sakazakii*

Members of the genus *Cronobacter* are motile, non spore forming, rod shaped, gram negative facultative anaerobes (Chenu *et al.*, 2009). *Cronobacter* species are opportunistic pathogens and are linked with life threatening infections in neonates (Johler *et al.*, 2010; Hartmann *et al.*, 2010). Till 1980 *Cronobacter* was known as ‘yellow pigmented *Enterobacter cloacae*’ then it was designated as *Enterobacter sakazakii* (Farmer *et al.*, 1980).

*Cronobacter sakazakii* are responsible for causing rare but severe forms of meningitis, sepsis and necrotizing enterocolitis (NEC) in newborn infants and neonates (Acker *et al.*, 2001; Hunter *et al.*, 2008; Muytjens *et al.*, 1983; Biering *et al.*, 1989; Bar-Oz *et al.*, 2007). The infant mortality rate reported due to infection of this organism is 40-80%. 20% of neonates that survive develop serious neurological complications such as quadriplegia, hydrocephalus and retarded neural development (Iverson *et al.* 2003). Chances of infection are 15% in infants born to HIV-positive mothers because of breastfeeding if no preventive interventions are implemented. These bacteria have been also recognized as the causative agents of various infections in elderly adults suffering from serious underlying disease or malignancy (Dennison and Morris 2002; Gosney 2008). To reduce or to prevent the hazards posed by *C. sakazakii*, an accurate, rapid, and highly sensitive detection protocol is needed (Drudy, 2006).

The organism causes disease by crossing the intestinal barrier and establishes a systemic infection (Kim *et al.* 2008). Virulence studies have shown that the organism is capable of surviving in macrophage cells and cells efficiently attach to and invade epithelial cell lines (Paggoto *et al.* 2003). The organism produces exopolysaccharide which leads to the formation of biofilm and active efflux pumps that promotes resistance to antimicrobial agents such as bile salts and disinfectants (Healy *et al.* 2010). A zinc containing metalloprotease that has collagenolytic activity is synthesized by *Cronobacter* that allows the organism to cross blood brain barrier (Kothary *et al.* 2007).

There is very less information about the natural reservoir of this organism but it has been isolated from food processing plants and food products, including cheese.
products, cured meats, vegetables, herbs and spices. The presence of *E. sakazakii* was not restricted to dry products. Fresh, frozen, ready-to-eat, fermented and cooked food products as well as beverages and water suitable for the preparation of food, were found to be contaminated by *E. sakazakii*. Food and food ingredients may be contaminated with *E. sakazakii* under conditions of hygiene mismanagement by contaminated insects (Kuzina *et al.* 2001; Hamilton *et al.* 2003) and rats (Gakuya *et al.* 2001). Powdered infant formula (PIF) is one of the main food sources for this organism (Iverson *et al.* 2004; Weir 2002; Drudy *et al.* 2006; Mullane *et al.* 2006; Iverson *et al.* 2003). The organism has been isolated from powdered milk processing plants as well as hospital utensils (spoons and blenders) used to prepare infant formula (Forsythe 2005).

There are many factors responsible for the persistence of this organism in dry milk and PIF products. It was isolated from wide spectrum of environmental sources (Farmer *et al.*, 1985; Drudy *et al.*, 2006) including water (Farmer *et al.*, 1985), waste (Dudley *et al.* 1980) and thermal spring water (De Los Angeles Mosso *et al.*, 1994), soil (Khan *et al.*, 1998), dust from households and food production-lines (Kandhai *et al.*, 2004). In comparison to other members of the *Enterobacteriaceae*, this organism has remarkable resistance to osmotic stress and dessication. The organism can persist under dessicated conditions in infant formula for over two years (Breeuwer *et al.*, 2003; Barron *et al.*, 2007).

The organism produces a yellow pigment that may protect the cells against UV rays and also has the ability to form capsules and fimbriae that enable the organism to adhere to different surfaces (Mullane *et al.*, 2006). Presence of all these physiological characteristics enhances its survival in the food as well as in other environmental sources such as water, soil, and vegetables.

**LACTIC ACID BACTERIA**

Lactic acid bacteria (LAB) have long been used in fermentations to preserve the nutritive qualities of various foods. The primary antimicrobial effect exerted by LAB is the production of lactic acid and reduction of pH (Daeschel, 1989). In addition, LAB produce various antimicrobial compounds, which can be classified as low-molecular-mass (LMM) compounds such as hydrogen peroxide (H$_2$O$_2$), carbon dioxide (CO$_2$), diacetyl (2,3-butanedione), uncharacterized compounds, and
high-molecular-mass (HMM) compounds like bacteriocins (Jay, 1982; Klaenhammer, 1988; Piard and Desmazeaud, 1991, 1992). All of which can antagonize the growth of some spoilage and pathogenic bacteria in foods.

**PLANT PRODUCTS**

Plant extracts possess bactericidal and bacteriostatic effects (Lee, 2001) and most of these plants contain many active compounds. Consequently, they are multipurpose drugs at the same time (Negi et al., 2000). Plants are a rich source of natural products used for centuries to cure various diseases. The plant-derived medicines are based upon the premise that they contain natural substances that can promote health and alleviate illness (Swayamjot et al., 2005 and Kumar et al., 2007). It was also postulated that phenol compounds in water extracts of onion posses antibacterial activity against *Staphylococcus aureus*. Many other compounds such as flavonoids, tannins quinines and coumarins had been extracted from different plants and found to be of inhibitory effect on numerous bacteria strains as well as fungi and yeast (Leon et al., 2001). Aloe vera posses different therapeutic features, since it contain “Emodin” in leaves. These leaves extracts were used to cure ulcers for its inhibitory effect on Helicobacter pylori (Joshi, 1998).

Antibacterial effects of some plants including Thyme, Oregano, Wild tea, Wild mint, Sage and Fennel and their derivatives were extensively investigated against food spoilage and pathogenic bacteria in vitro by many researchers (Sagdic et al., 2005).

- **Amla (Emblica officinalis)**

  The plant belongs to the family *Euphorbiaceae*. It has great medicinal and nutritive values. *E officinalis* have the antibacterial (Hossain et al., 2012; Philip et al., 2012 and Usha et al., 2012), antifungal (Hossain et al., 2012 and Mehmood et al., 1999), antioxidant (Golechha et al., 2012), cardio protective (Bhattacharya et al., 2002), antihelmintic (Dwivedi et al., 2004) and anti-inflammatory properties.
The plant *E. officinalis* is useful in conjunctivitis, inflammation, dyspepsia, ulcerative stomatitis, gastrohelicosis, cough, diarrhoea, dysentery, diabetes, asthma, bronchitis, opthmopathy, colic, jaundice, emaciation, cardiac disorder, intermittent fever, hepatopathy, hemorrhages, menorrhagia and skin diseases. It contains vitamin C, tannins and flavonoids which are antioxidant in action (Kaur *et al.*, 2002).

Various reports are available confirming the *in vitro* and *in vivo* antibacterial potency of *E. officinalis*. In an experimentally induced pneumonia with *Klebsiella pneumoniae* in mice, the fruits of *E. officinalis* were reported to inhibit the colonization of organism in lungs (Saini *et al.*, 2008).

**Clove (Syzygium aromaticum)**

It belongs to the family *Myrtacae* (Shyamala *et al.*, 2003). It is used as flavouring agents and as spice for scenting, chewing tobacco. It is aromatic, stimulant & carminative, used for dyspepsia and gastric irritations. *Syzygium aromaticum* buds and their essential oils have been known to possess various antimicrobial and antioxidant properties (Fu *et al.*, 2007). The major constituents of *Syzygium aromaticum* oil are eugenol acetate, eugenol and caryo-phyllene and the latter two are known to possess antibacterial and antifungal properties (Nassar *et al.*, 2007; Ayoola *et al.*, 2008).

**Triphala (Combination of fruits of Terminalia chebula, Emblica officinalis, and Terminalia bellirica)**

It is a combination of three tropical fruits preparation comprised of equal parts of *Terminalia chebula, Emblica officinalis, and Terminalia bellirica*, which gently promotes internal detoxification of all conditions of stagnation and improving digestion and assimilation. There is widespread interest in drugs derived from plants, which leads to the screening of several medicinal plants for their potential antimicrobial activity (Hussain *et al.*, 2007).