Effect of addition of whey protein concentrate on physico-chemical attributes of Khoa

NS Dhadge, RJ Desale and AR Deshmukh

Abstract
Khoa was prepared by incorporating WPC. Whey proteins could be produced with wide range of functional properties. Considering excellent functional characteristics WPC, the efforts were made through present investigation to assess the Effect of Addition of Whey Protein Concentrate on Attributes of Khoa”. With this hypothesis, is planned with objective to study the physico-chemical and organoleptic properties of Khoa added by WPC. According to treatments, samples of Khoa were prepared and evaluated for sensory and physico-chemical quality. The present study was found that the levels of WPC added at the level of 3%, 5% and 7% were selected for further study. The experiment was laid out in Completely Randomized Design (CRD) with four replications. Data obtained were analysed as per Snedecor and Cochran, (1994).

The treatment T1 (Khoa + 5 % of WPC) was rated best among Khoa samples and was comparable to control Khoa. The chemical composition of treatment T2 19.20% fat, 0.69 acidity, 27.57% protein, 19.13% lactose, 4.67% ash, 6.00 pH, 77.01% total solid, 23.00% moisture.

Keywords: Whey protein concentrate, fat, acidity protein, lactose, ash, pH, total solid, Khoa

Introduction
The consumption of milk and dairy products is common in the world India produces approximately 165.4 million tonnes milk production and per capital availability of milk is 355gms/ day (Anonymous, 2017). Around 50 per cent of total milk produced in India is converted to traditional milk products (Bandopadhyay et al. 2006). Khoa or Mawa is an important indigenous heat desiccated, partially dehydrated milk product which is very popular in large section of population throughout the country. In India, about 6,00,000 of Khoa was being produced annually by utilizing about 7% of total milk produced in the country (Aneja et al. 2002).

Dairy industry has emerged as a fast growing and large scale producer of novel and nutritionally enriched milk based products, with efficient and profitable utilization. Indigenous milk products i.e. fermented, acid coagulated and byproducts like whey, skim milk, butter milk, ghee residue are noticeable since time immemorial. Right now these milk based products and byproducts are reproducing into various newer generation products with improving its characteristics and dietetic properties. Whey based products exist and get hold of positively to this innovative group.

Depending on the end use and the quality of the milk used, mainly 3 commercial types of Khoa are identified namely Pindi, Dhap and Danedar. Khoa is highly nutritious food having 90% digestibility coefficient of proteins and 69% biological value. Although milk is a poor source of iron, Khoa provides adequate amount of iron which is incorporated during the process of Khoa preparation in an open vessel made up of iron (Bala Subramanayam, et al. 1955).

Whey proteins are supplemented to provide antimicrobial activity, immune modulation, improved muscle strength and body composition, and to prevent cardiovascular disease and osteoporosis. Whey proteins have become a staple supplement of many bodybuilders and other athletes.

Whey proteins have different fractions, some of them are in large concentration like β-lactoglobulin, α-lactalbumin, serum albumin, immunoglobulins) and others are in low concentration, such as (Lactoferrin, lactoperoxidase, lysozyme, etc). Whey protein has a biological value of 104, which is a higher score than casein, soya protein, beef and wheat...
WPC is rich in essential amino acids such as lysine, tryptophan, cysteine and methionine. Whey protein is an acceptable protein source for healthy pregnant women and children provided they are not allergic to dairy proteins. It is highly soluble and very easy to digest. This is one of the reasons it is commonly used in infant formula and protein supplements for medical use. It was found to inhibit the growth of tumors more effectively than other food proteins (Kassem, 2015) [14].

Whey Protein Concentrate-80 (WP-80, which means it contains 80% proteins in its composition) is a rich source of peptides and amino acids obtained from milk, which are used in the production of functional food (Krol, et al. 2008) [15]. Whey proteins exert a wide range of health-beneficial properties affecting the cardiovascular system. Whey protein helps to control the blood glucose level and provides additional benefits for weight management which is a concern for type-2 diabetics (Shankar and Bansal, 2013) [19]. Utilization of whey protein concentrate in the manufacture of indigenous dairy products is still at its infancy. Whey protein concentrates (WPC) are an important protein source having excellent functional characteristics such as emulsification, gelling and foaming. An important functional property of WPC is their ability, under appropriate conditions to form heat induced viscoelastic gels capable of immobilizing large quantities of water and other food components (Ikeda an Foegeding, 1999) [18].

### Materials and Methods

#### Milk

The fresh clean, composite cow milk was procured from Research cum Development Project on Cattle, Department of Animal Husbandry and Dairy Science, M.P.K.V., Rahuri.

#### Whey protein concentrate

The 80% whey protein concentrate was made available from local market.

#### Chemicals

All the chemicals used in study for the analytical purpose were of analytical (AR) or guaranteed reagent (GR) grade by Merk, India Ltd and Glaxo India Ltd.

### Chemical analysis of milk and Khoa

The fresh clean, composite cow milk sample collected from Research- cum- Development Project on Cattle and analysed for chemical constituent of milk was carried out for moisture, fat, protein, total solids, lactose, pH, ash and acidity by using slandered operating methods.

<table>
<thead>
<tr>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khoa was prepared by using cow milk. The resultant Khoa blended with WPC at various levels in preliminary trials based on weight of Khoa. Accordingly, 1%, 3%, 5%, 7%, 9% and 11% WPC was used in the preliminary trials. On the basis of sensory evaluation the 3%, 5% and 7% level were finalized. The Khoa was prepared as per the procedure described by Sachdeva and Rajorhia, (1982) [18] with some modification.</td>
</tr>
</tbody>
</table>

### Flow diagram for preparation of khoa using WPC

Cow milk

Continuous boiling of milk with stirring in karahi

Concentration

Stirring / scrapping viscous semi solid mass

Semi solid mass of milk

Leaves the bottom / surface of karahi

Addition of Whey Protein Concentrate

(1%, 3%, 5%, 7%, 9% and 11%)

Stop heating

Allow to cool

Khoa
Statistical design
The experiment was laid out in Completely Randomized Design (CRD) with four replications. Data obtained were analysed as per Snedecor and Cochran, (1994) [21].

Result and Discussion
The milk used for preparation of WPC added Khoa had an average 3.76 per cent fat, 3.65 per cent protein, 4.41 per cent lactose, 0.69 per cent ash, 12.50 per cent total solids and 0.14 per cent acidity.

Table 1: Chemical analysis of Whey Protein Concentrate

<table>
<thead>
<tr>
<th>Particular</th>
<th>WPC (80%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>7.00</td>
</tr>
<tr>
<td>Protein</td>
<td>80.60</td>
</tr>
<tr>
<td>Lactose</td>
<td>4.45</td>
</tr>
<tr>
<td>Ash</td>
<td>4.01</td>
</tr>
<tr>
<td>Moisture</td>
<td>3.94</td>
</tr>
<tr>
<td>Total Solids</td>
<td>96.06</td>
</tr>
</tbody>
</table>

(Gavhane, 2016)

Table 2: Chemical analysis of Khoa

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>21.12</td>
</tr>
<tr>
<td>Protein</td>
<td>22.16</td>
</tr>
<tr>
<td>Acidity (%)LA</td>
<td>0.66</td>
</tr>
<tr>
<td>Lactose</td>
<td>17.78</td>
</tr>
<tr>
<td>Ash</td>
<td>3.92</td>
</tr>
<tr>
<td>Total Solid</td>
<td>75.22</td>
</tr>
<tr>
<td>Moisture</td>
<td>24.78</td>
</tr>
</tbody>
</table>

Chemical evaluation of WPC added Khoa

Table 3: Effect of admixture of WPC on Physico chemical composition of Khoa

<table>
<thead>
<tr>
<th>Addition of WPC %</th>
<th>Moisture</th>
<th>Fat</th>
<th>Protein</th>
<th>Lactose</th>
<th>Ash</th>
<th>Acidity</th>
<th>pH</th>
<th>Total Solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0 Control</td>
<td>24.78</td>
<td>21.12</td>
<td>22.16</td>
<td>17.78</td>
<td>3.92</td>
<td>0.66</td>
<td>6.04</td>
<td>75.22</td>
</tr>
<tr>
<td>T1 (3%)</td>
<td>23.89</td>
<td>20.15</td>
<td>26.37</td>
<td>18.70</td>
<td>4.41</td>
<td>0.67</td>
<td>6.00</td>
<td>76.12</td>
</tr>
<tr>
<td>T2 (5%)</td>
<td>23.00</td>
<td>19.20</td>
<td>27.57</td>
<td>19.13</td>
<td>4.67</td>
<td>0.69</td>
<td>5.84</td>
<td>77.01</td>
</tr>
<tr>
<td>T3 (7%)</td>
<td>22.38</td>
<td>18.22</td>
<td>29.76</td>
<td>19.76</td>
<td>4.69</td>
<td>0.70</td>
<td>5.79</td>
<td>77.62</td>
</tr>
<tr>
<td>SE</td>
<td>0.071</td>
<td>0.12</td>
<td>0.022</td>
<td>0.072</td>
<td>0.032</td>
<td>0.005</td>
<td>0.039</td>
<td>0.071</td>
</tr>
<tr>
<td>CD @5%</td>
<td>0.218</td>
<td>0.37</td>
<td>0.69</td>
<td>0.222</td>
<td>0.100</td>
<td>0.015</td>
<td>0.121</td>
<td>0.218</td>
</tr>
</tbody>
</table>

Moisture
The influence of WPC treatments on moisture content of Khoa was statistically significant. The moisture content of Khoa prepared by adding WPC, was 23.89 (T1), 23.00 (T2) and 22.38 (T3) percent respectively where as for control (T0) it was 24.78. These moisture contents of Khoa decreased with increasing level of WPC from treatment T3 to T1. WPC 80 contain about 96.06 per cent total solids and remaining are moisture i.e only 3-4 per cent means WPC is a dried product and because of that, as per increasing WPC levels in Khoa the moisture content was decreasing in the final product.

Fat
The importance of fat in dairy products is highly regarded because it plays a distinguishable role for adding taste and richness to the products. Hence, the observations on fat content of Khoa as influenced by different levels of WPC have been recorded and statistically analysed to arrive at definite conclusions. The influence of experimental treatments on fat content of Khoa was significant. It was observed that fat content is varied between the range of 18.22 to 21.12 percent. The WPC level in Khoa had very little effect on its fat content. The increase in moisture content of Khoa resulted in decreased content of fat.

Protein
The significance of protein in dairy products is highly regarded due to its distinguishable role for adding nutritional value to the products.
quality to the products. The influence of whey protein concentrate treatments on protein content of Khoa was statistically significant. The mean value of protein content were 22.16 (T0), 26.37 (T1), 27.57 (T2), and 29.76 (T3) per cent respectively. The protein content of Khoa increased with incorporation of WPC. Pandiyan et al., (2010) studied the incorporation of WPC in ice cream. They observed that protein content is increasing with addition of WPC.

Lactose
Lactose is a carbohydrate (Sugar) which is only present in milk. Lactose plays important role in milk as a sweetening agent. It was observed that the average lactose content in T0, T1, T2 and T3 were 17.78, 18.70, 19.13 and 19.76 per cent respectively. All the treatments showed the significant difference that, lactose per cent of Khoa increase as increase in level of WPC. Treatment (T2) and (T3) has maximum lactose content.

Ash
All the treatments showed the significant difference for ash contents in WPC added Khoa. Average ash content in T0, T1, T2 and T3 were 3.92, 4.41, 4.67, 4.69 per cent respectively. Ash per cent of Khoa increased with increasing level of WPC. Treatment T0 (Control) contain lower (3.92) per cent ash and treatment T3 contain maximum (4.69) per cent ash.

Acidity (% L.A)
Presence of acidity in any milk product has its own significance. Acidity may be “natural” or “developed”. Natural acidity is inherent acidity having specific range for that particular product. Any figure more than that may attribute to addition of other substance having higher acidity. The shelf life of any product is depends on its developed acidity. With the increase in the level of WPC the acidity of Khoa also get increased. The acidity of the experimental treatment was ranged between 0.66 to 0.69 percent of lactic acid.

Dewani PP (2011) studied on ‘Effect of admixture of WPC and SCBM on Various attributes of Khoa and Khoa based Sweets’ which contain 0.79 to 0.83 per cent acidity.

pH
The average pH content in T0, T1, T2 and T3 were 6.04, 6.00, 5.84, 5.79 per cent respectively. All the treatments showed the significant difference for pH contents in WPC added Khoa. The pH of Khoa decrease as increasing in level of WPC.

Total solid
The total solid content of WPC added Khoa ranges between 75.22 to 77.62 per cent and noted the significant difference between the treatments. The increasing trend in Total Solids of Khoa was observed with increase in WPC levels. This might be due to higher total solid (96.06) per cent content in WPC.

Conclusion
It is concluded that the Whey can be efficiently used in the preparation of Khoa. Good quality Khoa can be prepared by addition of 5% Whey Protein Concentrate with 19.20% fat, 0.69 acidity, 27.57% protein, 19.13% lactose, 4.67% ash, 6.00 pH, 77.01% total solid and 23.00% moisture content.

References