Skim Milk Powder (SMP)

Skim milk powder (SMP) has low moisture and fat contents and, when stored in dry, cool conditions, has a shelf life in excess of two years. Specifically, when stored at 15°C and a relative humidity of 75 per cent skim milk powder has a minimum shelf life of two years, an average shelf life of three years and a maximum shelf life of four years. Milk powders are hygroscopic: they tend to attract water readily from humid atmospheres. When moisture levels are excessive, milk powders may become sticky, caked or lumpy, and exhibit reduced flow ability and solubility. These changes affect the ease of use of the product, requiring grinding for example and may affect the flavor, but do not represent a health or safety problem. If the powder's moisture content exceeds 15 per cent, it then becomes susceptible to microbiological growth and should not be used.

Typical Composition

Particulars	Specifications
Protein	34.0% - 37.0%
Lactose	49.5% - 52.0%
Fat	0.6% - 1.25%
Ash	8.2% - 8.6%
Moisture	3.0% - 4.0% (non-instant) 3.5% - 4.5% (instant)

Physical and Chemical Characteristics

Typical Microbiological Parameters	
Standard plate count	< 10,000 cfu/g*
Coliform	≤ 10/g (maximum)
E.coli	Negative
Salmonella	Negative
Listeria	Negative
Coagulase-positive staphylococci	Negative
Other Characteristics:	
Scorched particle content	7.5 - 15.0mg (spray-dried)
	22.5mg (roller-dried)
Titratable acidity	0.14 - 0.15%
Solubility index	1.0 ml (instant)
	1.2 ml (spray-dried, low-heat)
	2.0 ml (spray-dried, high-heat)
	15.0 ml (roller-dried)
Color	White to light cream color
Flavor	Clean, pleasing dairy flavor

Source: USDA

Skim milk powder should have a mild flavor and aroma. After extended storage, some milk powder may develop slight off-flavors. These may be noticed in rehydrated or "recombined" milk products. However, milk powders for use as ingredients in manufactured foods and dry blends generally do not need to meet as high standards of palatability and redispersibility.

Influence of storage on chemical and physical properties of skim milk powders

Which flavor changes can be expected?

- The flavor and odor of milk powder should be sweet and clean, entirely free from rancid or other objectionable odors.
- Off-flavors developing in dried milk products during storage may be due to many different compositional, processing or other variables.
- The occurrence of off-flavors may also be an indication of spoilage, microbial growth, or contamination. Bags of milk powders should be stored in a dry, clean area. Contact with spoiled foods, wet cardboard, wood or any other material that may be moldy or has the potential to support mold growth should be avoided.
- At high storage temperatures, these types of flavors have been described in dried milk products. A slight caramelized taste is objectionable in products such as yogurts, ice cream and similar products.

Is solubility affected by extended storage?

- Extended storage of dried milk products may result in decreased solubility of proteins. The insolubility is generally attributed to the Maillard reaction, which involves reducing sugars and proteins.
- Storage studies of dried milk products have shown that the products stored in a variety of conditions could exhibit slight changes of solubility.
- The changes are not commercially important, yet it remains preferable to store milk powders at temperatures well below 40°C for a maximum retention of solubility characteristics over a long period of time.
- The term solubility is also used to describe the dispersing characteristics of milk powders when reconstituted with water or other fluids. Tests to determine the "solubility" of milk powders depend upon a number of factors such as the amount of dissolved minerals, "hardness", in the water used, speed and duration of stirring and temperature, and other factors. The use of mechanical agitation and mild heat in sanitary conditions may be required to facilitate "wetting" and dispersion of some milk powders. For uses where the powder is blended with other dry ingredients as, for example, in baked goods, the degree of solubility of milk powder is not very critical.

What is the impact of browning on functionality of milk powders?

- A powder that has developed extensive browning or appears to have deteriorated should not be used. Slight browning may be associated with flavor changes, making the powder less desirable in applications such as yogurt, ice cream and other dairy products.
- These changes, however, are not noticeable in bakery applications. Some studies have shown, in fact, that volume of baked goods can increase with the length of storage and degree of browning of dried milk ingredients. Typically, the level of protein denaturation achieving during the processing of milk powders is a more significant indicator of performance for industrial bakers than small changes occurring during storage.

What is the impact of storage on the powder's acidity? (i.e. pH level)

- In some studies, the pH of milk powders stored at room temperature was shown to decrease. The pH change can also be attributed to the bonding of amino groups by lactose in the Maillard reaction. Changes in pH do not appear to be significant for a milk powder user at the commercial level.
- A milk powder that has deteriorated extensively as a result of poor storage conditions, and that appears to have an unpleasant, acidic taste, should not be used.

What is the impact of storage of flow properties?

- Skim milk powder is hygroscopic (attracts moisture) because of its high lactose content. If exposed to the atmosphere it can absorb sufficient moisture to induce caking or the development of lumps, resulting in a powder that flows poorly or not at all.
- Proper storage conditions and good packaging can reduce stickiness, caking, and lumpy problems.

Recommended Uses of a Function of Heat Treatment

Classification	Typical Processing Treatment	Un-denatured Whey Protein Nitrogen* (mg/g)	Recommended Applications
Low-heat	Cumulative heat treatment of milk not more than 70°C for 2 minutes	≥ 6.00	Fluid milk fortification, cottage cheese, cultured skim milk, starter culture, chocolate dairy drinks, ice cream
Medium-heat	Cumulative heat treatment of 70 -78°C for 20 minutes	1.51 - 5.99	Prepared mixes, ice cream, confectionery, meat products
High-heat	Cumulative heat treatment of 88°C for 30 minutes	≤ 1.50	Bakery, meat products, ice cream, prepared mixes

Source: USDA

Influence of storage on the nutritive of skim milk powders

Lysine and the sulfur-containing amino acids are principal among those that suffer some slight destruction during the high temperature treatments of milks or Maillard reaction. Protein quality losses can occur during normal storage. Studies have shown that methionine and tryptophan content do not change significantly during storage at temperatures ranging from –40 to 40°C and water activities in the 0.15 to 0.41 range.

The available lysine decreases most at high water activity and at the highest temperature. However, losses of lysine after 6 months of storage at 20°C (at any water activity level) are less than 8% (typically less than 6%.) It is only during extended storage (over 6 months) at temperatures exceeding 40°C and at high water activity that the loss of lysine, and therefore the change of nutritional quality of milk proteins, becomes more significant (with losses of 15-24%). Such extreme conditions are rarely encountered in commercial situations.

Is the biological value of milk protein reduced during storage?

The biological value of milk proteins is not significantly altered during the manufacture of milk powders or during storage in good conditions for an extensive period of time. Maintaining the nutritional value of milk proteins during storage is not a problem, provided the temperature is kept below 40°C and water activity (humidity) low.

Is vitamin content affected by storage in milk powders?

The amounts of thiamin (B1), riboflavin (B2), niacin, calcium pantothenate, biotin, and pyridoxine present in dried milk are quite comparable to those of market milk and are not affected by storage for 6 months at 35°C. Vitamin C content is slightly reduced during storage for 6 months.

Expected shelf-life

What is the expected shelf life of milk powder that has been transported or stored for three months at temperatures above 35°C?

Storage at high temperatures can reduce shelf-life because some reactions, such as non-enzymatic browning, are temperature-dependent. It is the combination of heat and high humidity that will significantly reduce shelf-life. For example, studies have shown that storage for 3 months at 37°C and 90 per cent relative humidity is equivalent to storage for 12 months at ambient temperature in temperate climates (approx. 15-25°C, 80 per cent RH or less). Therefore, the remaining shelf-life may be reduced by a factor of 4 if the powder is stored in high heat/ high moisture conditions.

Increases in the moisture content of the milk powder will cause browning and caking first, and while SMP will be safe, it will be harder to use. Further increases in the moisture content of SMP (above 15 per cent) may allow bacterial growth and the SMP should not be used.

If the uptake of moisture is due to packaging failure or punctures, or if it appears that the product has been tampered with in any fashion, the milk powder should not be used.

Storage and safety issues

Milk powder made from good quality milk and containing low microbial counts is microbiologically safe during storage, provided the moisture content is kept low during storage. Bacteria, yeast and mold will not grow in milk powder that has been stored in good conditions. Powder that has been exposed to water or excessive humidity during storage (so its moisture content is above 15 per cent) can sustain microbiological growth and should not be used.

Testing quality

Milk powders should be evaluated organoleptically, chemical-physically, and microbiologically to fully determine the quality and condition. However, an organoleptic evaluation test is the only test that can be performed with minimum equipment. The organoleptic evaluation of reconstituted skim milk powder should have a taste and smell close to that of milk. A slight cooked flavor and smell is acceptable.

Global Production Trend

From the adjacent table we can see that the global production over the years have shown gradual improvement. It showed an increase of about 34.58 per cent over the last 15 years. Likewise the import, consumption and export grew by 47.53, 27.51 and 89.28 per cent respectively. The positive fact about the SMP trade is the growth in the consumption over the years in the non-producing countries, which has resulted in sharp increase in exports. If this pattern of consumption (rate of growth) continues in the coming years, the prices are bound to maintain a steady as the supply is always going to lag behind the demand. There has been a significant decline in the global ending stock over the last fifteen years, which is

World Supply & Demand Statistics ('000 MT)

Years	Production	Imports	Total Supply	Exports	Dom. Consumption	Ending Stocks
2001	3,285	810	4,688	989	2,973	726
2002	3,595	829	5,146	1,117	3,097	932
2003	3,541	862	5,335	1,139	3,298	898
2004	3,156	846	4,897	1,120	3,221	556
2005	3,237	827	4,620	1,020	3,225	375
2006	3,125	780	4,279	1,069	2,957	253
2007	3,223	800	4,276	1,088	2,906	282
2008	3,320	846	4,448	1,102	3,007	339
2009	3,452	830	4,616	1,140	2,920	556
2010	3,398	869	4,823	1,316	3,005	502
2011	3,675	996	5,173	1,529	3,192	452
2012	3,983	1,070	5,505	1,627	3,447	431
2013	3,953	1,146	5,530	1,663	3,482	385
2014	4,371	1,132	5,888	1,823	3,606	459
2015	4,421	1,195	6,075	1,872	3,791	412

Source: USDA

the price supporting factor but I feel that the contraction of demand in the recent times from European Union & Middle East is going to comfortably negate the gradual decline in the ending stock and keep the pressure on the prices.

Country wise Supply & demand of SMP

The European Union Continues to be the largest producer of SMP registering an increase of 50.94 per cent in the last five year. The maximum growth has been noticed in case of Mexico (323.08 per cent), followed by Russia (102.38 per cent), South Korea (60.00 per cent) and India (44.74 per cent). During the same period the world's production has increased by 30 per cent. The top five SMP producers of the world are European Union (36.19 per cent), United States (22.51 per cent), India (12.44 per cent), New Zealand (9.05 per cent) and Australia (4.41 per cent). European Union also tops the list of consumers with (25.09 per cent) followed by United States (13.08 per cent), India (12.40 per cent), China (9.50 per cent) and Mexico (6.99 per cent). Significant jump in consumption of SMP in the last five years has been noticed in case of China (150.00 per cent), South Korea (76.19 per cent), Mexico (57.74 per cent) and Australia (51.79 per cent).

SMP Production and Consumption: Summary For Selected Countries ('000 MT)

Country	2010	2011	2012	2013	2014	2015 Dec
	Production					
European Union	1060	1180	1270	1250	1550	1600
United States	824	882	973	956	1026	995
India	380	430	450	490	520	550
New Zealand	344	366	404	404	410	400
Australia	205	230	235	215	205	195
Brazil	130	132	141	151	154	157
Japan	156	137	139	136	120	130
Russia	42	55	57	56	80	85
Canada	72	76	85	74	77	80
Mexico	13	26	55	55	55	55
Ukraine	53	43	52	52	55	55
China	55	56	57	54	49	50
Argentina	35	39	32	34	38	36
Chile	19	19	19	14	17	17
Korea South	10	4	14	12	15	16
World	3398	3675	3983	3953	4371	4421
	Total Dom. Consumption					
European Union	749	807	802	848	912	951
United States	434	438	522	425	442	496
India	390	410	425	400	435	470
China	144	186	225	289	334	360
Mexico	168	220	291	253	255	265
Indonesia	184	197	205	222	215	217
Brazil	144	163	174	175	176	178
Japan	187	179	173	168	173	173
Russia	159	126	153	184	161	165
Algeria	98	106	116	125	125	125
Philippines	97	92	96	103	98	108
Australia	56	68	76	80	85	85
Canada	73	73	68	72	70	70
Korea South	21	38	27	31	36	37
Ukraine	41	23	29	42	27	27
Taiwan	19	22	21	21	22	23
Chile	20	22	23	23	21	21
Argentina	18	19	18	17	15	16
New Zealand	3	3	3	4	4	4
World	3005	3192	3447	3482	3606	3791

Source: USDA

Indian Balance Sheet for SMP

From the table below we can see that the Indian production over the years have shown sharp improvement. It showed an increase of about 214.29 per cent over the last 15 years. Likewise the consumption and export have also grown by 158.24 per cent and 900.00 per cent respectively. The positive fact about the SMP trade is the growth in the consumption over the years in the non-producing countries, which has resulted in sharp increase in exports. If this pattern of consumption (rate of growth) continues in the coming years, the prices are bound to maintain a steady as the demand is always going to lag behind the supply in the Indian Market.

Indian Balance Sheet for SMP ('000 MT)

Year	Production	Imports	Total Supply	Total Exports	Dom. Consumption	Ending Stocks
2001	175	0	224	8	182	34
2002	190	0	220	11	195	14
2003	210	4	228	9	215	4
2004	245	0	249	17	218	14
2005	266	0	280	52	225	3
2006	300	0	303	33	260	10
2007	310	0	320	32	270	18
2008	351	0	369	44	310	15
2009	360	3	378	15	355	8
2010	380	20	408	18	390	0
2011	430	32	462	3	410	49
2012	450	14	513	37	425	51
2013	490	0	541	130	400	11
2014	520	0	531	80	435	16
2015	550	0	566	80	470	16

Source: USDA

India's Share in World SMP Trade ('000 MT)

Years	India	World	% Share
2001	8	989	0.81
2002	11	1,117	0.98
2003	9	1,139	0.79
2004	17	1,120	1.52
2005	52	1,020	5.10
2006	33	1,069	3.09
2007	32	1,088	2.94
2008	44	1,102	3.99
2009	15	1,140	1.32
2010	18	1,316	1.37
2011	3	1,529	0.20
2012	37	1,627	2.27
2013	130	1,663	7.82
2014	80	1,823	4.39
2015	80	1,872	4.27

Source: USDA

Moreover, with large price disparity between the Indian and foreign supplying countries (US & EU - have significantly lower prices) the SMP exporters are facing stiff competition and their share in world trade is consistently hovering below 5 per cent.

Direction of World trade in SMP ('000 MT)

Particulars	2010	2011	2012	2013	2014	2015 Dec
	Total Imports					
China	89	130	168	235	285	310
Indonesia	189	196	205	225	215	220
Mexico	155	194	236	198	200	210
Algeria	98	129	112	119	115	125
Philippines	110	111	106	113	100	115
Russia	117	71	96	131	85	85
Japan	30	27	32	32	45	45
Taiwan	19	22	21	21	22	23
Brazil	14	31	33	24	22	21
Korea South	8	34	19	20	21	21
Total	869	996	1070	1146	1132	1195
	Total Exports					
European Union	379	518	520	407	610	660
United States	384	435	445	555	545	516
New Zealand	343	362	390	392	360	395
Australia	132	140	168	119	150	145
India	18	3	37	130	80	80
Ukraine	14	22	26	12	30	30
Argentina	20	19	14	25	23	20
Canada	6	10	10	13	13	14
Russia	0	0	0	3	4	5
Philippines	15	17	12	6	5	4
Total	1316	1529	1627	1663	1823	1872

Source: USDA

Skim milk powder (SMP) – World Trade

Increased milk production and the addition of new drying plants in the EU boosted the production of SMP. Production is estimated to be up 26 per cent in the Jan-Sep 2014 period in comparison to the same period last year. As a result, the 2014 forecast production of SMP is raised by 11 percent to 1.55 million MT. During this same period, SMP shipments were up 58 per cent year-over-year and the 2014 export forecast is revised upwards by 14 per cent to 610,000 MT. As in 2013, Algeria and China are the leading destinations; however, this year sales to Algeria have surged with shipments through September

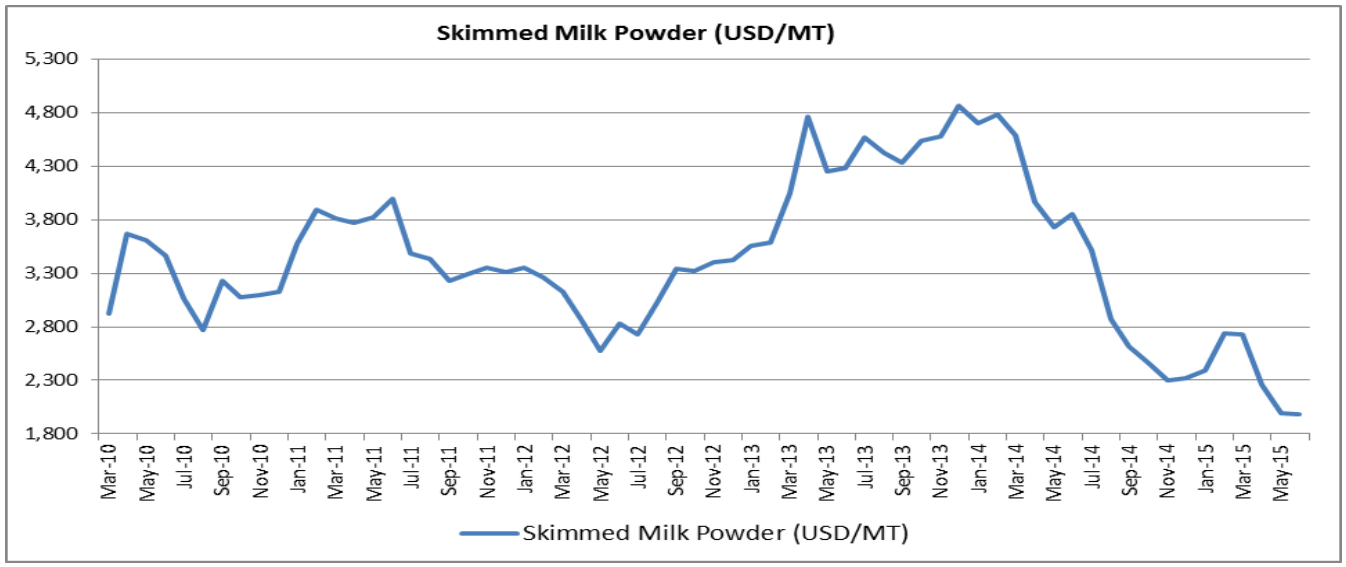
increasing by 176 per cent to 58,000 tons in comparison to the same period last year. Despite strong competitive pressures, exports are forecast to grow in 2015 by 8 per cent to 660,000 MT.

Following the strong pace of exports in the first half of the year, U.S. shipments of SMP have been weakening and the 2014 export forecast is revised down by 4 percent to 545,000 MT. Next year, U.S. shipments will face strong competitive pressures on world markets particularly in Asia, and the forecast is pegged at 516,000 MT – down 5 per cent from 2014.

Despite growing SMP production, India's exports have been lagging from last year's record setting level. Traditionally, India has shipped to Bangladesh, Pakistan and North African markets, but it appears that available exportable supplies have been constrained due to strong domestic consumption as growing incomes and a rising population is generating demand for dairy products. Consequently, the 2014 export forecast is cut by one third to 80,000 MT. This situation is likely to persist and an equal volume is forecast to be exported in 2015.

The 2014 SMP import forecast for China is increased slightly by 4,000 MT to 334,000 MT. For 2015, imports are expected to grow by 8 per cent to 360,000 MT which represents a more moderate pace in comparison to previous year's growth rates.

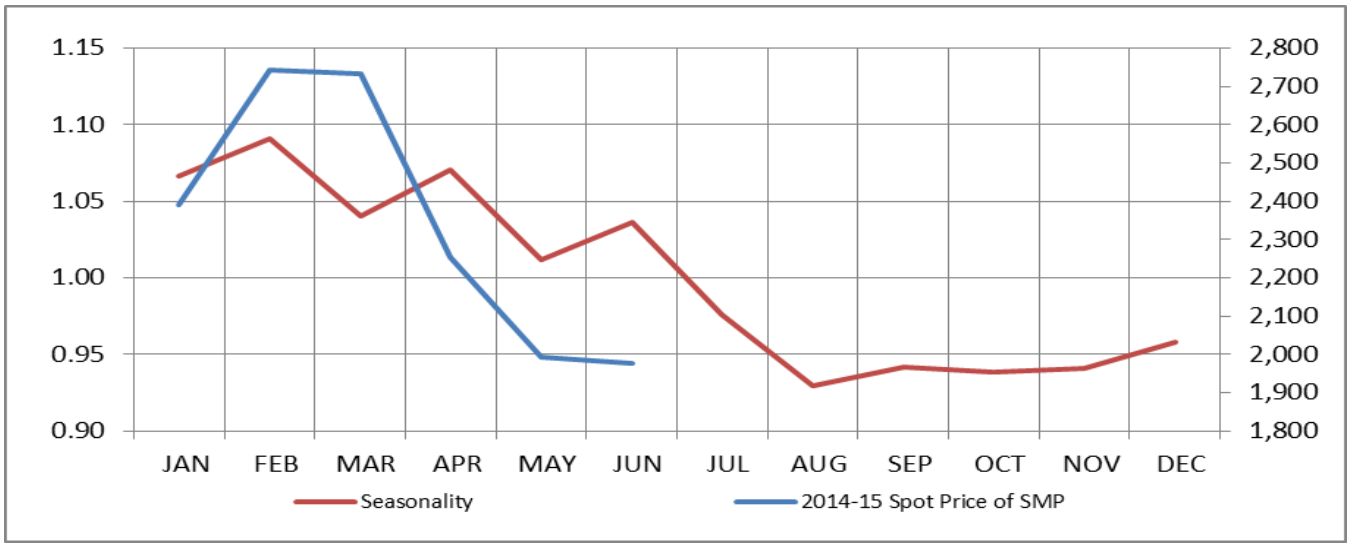
Price trend Analysis



The above plots suggest that the price of SMP is in its down trend. The global market is also facing problem of oversupply. The recent Abolition of European Union milk quota system in 2015 is set to create a new context for international trade in milk products citing a research study indicating increase in EU milk production by 3.5 million MT (18.4 per cent) to 22.6 million MT in 2022 over time. Correspondingly, the EU exports of milk products are also expected to increase to 15.74 per cent from 13.7 per cent.

According to EU Commission forecast, exports of SMP will go up from 4, 50,000 MT to 6, 25,000 MT in 2017. After the lifting of the quota restrictions, the EU nations are set to dominate global market in milk production and exports owing to the favourable climatic conditions wherein green fodder is available all through the year in plenty and the high milk-yield.

So far, dairies in India were able to export skimmed milk powder only because of the quota system that has been in existence for the last 30 years.



In India, a sudden abundance in the availability of green fodder fostered by the wetness in the coming weeks would lead to 20 to 30 per cent higher milk yield by cattle, causing additional complications for the dairies that are already unable to absorb even the normal production. Production of skim milk powder by private dairies has come to a grinding halt, as the global price has crashed to almost half of what existed some months ago. Most dairies, which are focused on production of skim milk powder, find no reason to continue with their usual procurement as the price of skimmed milk powder has crashed from Rs. 300 to less than Rs. 150 in the international market and the problem is only going to precipitate further in the coming months.