HANDBOOK
on Processing Technology
& Value Addition of
Wheat and Wheat Products
FINE CLEANING SOLUTIONS FOR THE FINEST WHEAT

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Dear Readers,

Greetings and best wishes!

Wheat supply chain and value chain in India, the second largest producer and consumer of wheat in the world, is transforming significantly. While the government of India continues to be the single largest buyer of wheat, the consumption market has spread far and deep into the southern and eastern India, in the last two decades. Besides, the forms of consumption too has been expanding, thanks to emergence of new product categories such as cookies, noodles and pastas, paving way for a vibrating processing industry. As a result, India has seen emergence of modern silo-based storage structures, large-scale chakki-based and newer technology-based atta mills, newer business models in the form of contract milling, specialised enzymes and additives for making special products, creative use of wheat germ and wheat bran and so on. The Handbook on Processing Technology and Value Addition of Wheat and Wheat Products is to summarise some of the recent trends in wheat supply and value chain in India.

I take this opportunity to thank all the experts - B S Muralidhara, D D Koditkar, Dr Hari Priya, Pramod Kumar, Ms Pallavi Oak, Ms Susanna S, Ms Ramya S, Ms Sarah Zimmerman, Dr Dayakar Rao, Ms Bhargavi G, J V Patil and A K Misra who have spared their time to contribute to this initiative and supported us. I thank the patrons who have chosen to brand their products and services in this special publication. I also thank the team at Foretell - Venkatraman, Ms Swapna, Ravi Bhandage, Vinay Soni, Ms Radhika, Chinna, Shiva Kumar and Gajendra for putting this handbook in six month time.

This is a beginning of our efforts to bring out useful information on wheat and wheat products. We endeavour to continue this effort in future too. In this direction, your comments and feedback are very valuable to us. Please send in your feedback to us at gsv@fbspl.com or publ@commodityindia.com.

Thank you and best wishes

G Srivatsava
President
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Wheat is an important food crop cultivated in India. It contributes highest share in the total production of crops grown during the Rabi season. In the last five years, India on an average produced 87 million tonnes of wheat from an average area of 29 million ha. Average productivity of wheat during the same period is around 3006 kg/ha. Indian wheat production has touched an all time high of close to 96 million tonnes during the year 2013-14.

Wheat production in India during the last decade- D1 (2003-2013) has grown up by 60% compared to the average production two decades ago- D3 (1983-93). Increase in the productivity has played major role in this jump, the average yield of wheat during 1983-93 was 2104 kg/ha which has increased by 35% to 2847 kg/ha during the year 2003-2013, while increment in the average area between these two decades are only 18%.

Table 1: Wheat Production Scenario in India

<table>
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<th>Decadal Production Scenario</th>
<th>Decadal Growth Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D1</td>
<td>D2</td>
</tr>
<tr>
<td>Area</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>Production</td>
<td>80</td>
<td>68</td>
</tr>
<tr>
<td>Yield</td>
<td>2847</td>
<td>2603</td>
</tr>
</tbody>
</table>

Area in Million Ha, Production in Million Tonnes, Yield in Kg/ Ha

The efforts employed to supply modern inputs, particularly of high- yielding variety seeds, fertilizers, and expanding the irrigation facilities have made improvement in the yield possible. Also, Indian Government’s ambitious program National Food Security Mission (NFSM) has provided wide support to enhance the availability of major food grains like Rice, Wheat and Pulses in the major growing regions. High yielding seeds, modern cultivation practices, farming equipments, on field training, and other financial assistance are provided to the farmers under NFSM program.

The NFSM program, started in the year 2006-07, is being implemented in the selected food grain producing states of India. Since then, the productivity of wheat has seen a continuous growth in those selected states. Minimum Support Price (MSP) also stepped up steeply around the same period which has lead to increase in production, as there was assured returns to farmers.

At present, out of the total wheat produced in India 92.1% are grown under the irrigated condition. Area under irrigated wheat has also increased from 81.1% during the year 2000-01 to 92.1% in the year 2010-11. In almost all major wheat producing states, more than 98% of the wheat is cultivated under irrigated conditions, however, in Madhya Pradesh and Maharashtra area under irrigated wheat is 87% and 73% respectively.

Fig 1: Year-wise Area, Production and Yield of Wheat in India

Fig 2: State-wise Area, Production and Yield of Wheat during the year 2003-2013
Uttar Pradesh is the largest wheat producing state of India. Punjab stands second in the total production followed by Haryana, Madhya Pradesh and Rajasthan. These top five states contribute 85% of the total wheat production of India. On the other hand, Madhya Pradesh, after Uttar Pradesh, stands at second position in terms of total area under wheat cultivation in the country.

It is interesting to note that increase in area under wheat by major contributors like Uttar Pradesh, Punjab and Haryana is minimal (below 1%) in the last 10 years (2003-2013) whereas, in Rajasthan, Gujarat and Madhya Pradesh the compounded annual growth in area is 4%, 4.7% and 2.1% respectively. Similarly, annual growth in production of wheat in Madhya Pradesh, Gujarat and Rajasthan during last 10 years is near to 6%, while in Uttar Pradesh, Punjab and Haryana the growth in around 3%.

**Table 2: State-wise Area, Production and Yield Growth (%) Comparison in the Last Two Decades**

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>Production</td>
<td>Yield</td>
<td>Area</td>
</tr>
<tr>
<td>Bihar</td>
<td>0.8</td>
<td>4.7</td>
<td>3.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Gujarat</td>
<td>4.7</td>
<td>6.5</td>
<td>1.7</td>
<td>-4.4</td>
</tr>
<tr>
<td>Haryana</td>
<td>1.1</td>
<td>3.5</td>
<td>2.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>2.8</td>
<td>6.4</td>
<td>3.5</td>
<td>-2.1</td>
</tr>
<tr>
<td>Punjab</td>
<td>0.2</td>
<td>1.9</td>
<td>1.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>4.0</td>
<td>5.5</td>
<td>1.4</td>
<td>-0.4</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>0.9</td>
<td>3.1</td>
<td>2.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Average productivity of wheat is highest in Punjab and Haryana states, i.e. 4400 Kg/ha; productivity or yield of wheat in Uttar Pradesh, Rajasthan and Madhya Pradesh states are 2865, 2932 and 1888 kg/ha respectively. Poor soil and water management in canal area, weed infestation specially in deep black soil, Lack of timely availability of inputs, especially seeds and fertilizers, and low seed replacement are the key reasons of lower productivity in Madhya Pradesh, apart bio-physical factors like forced heading and maturity due to short winter and temperature fluctuation added to it.

**Marketing of Wheat**
India has well established channel for marketing of wheat by the farmers. Wheat is marketed through both, private as well as government buying systems. The government procures wheat directly from the farmers at pre-declared Minimum Support Price (MSP). Also, the farmers can avail benefit of selling their wheat to the private players in the mandi (APMC) through the auction system. Food Corporation of India (FCI) procures wheat on behalf of the central government from farmers through state level cooperative and other nominated agencies.

Mainly two types of primary wheat marketing channels exist in India. Farmers will directly take their wheat to the government procurement center and sell or farmers will go to mandi (APMC) where the wheat is unloaded at the place of a commission agent (Arathia) and then auction will take place. Primary trading mainly happens during harvesting season (Mar-May), however, some large farmers will be selling their wheat after the non-season also to get the price advantage.

Transaction between trader and buyer (processors/other user) is termed as secondary trade. In this, farmers are not involved and stockiest or traders who bought the wheat earlier sell the wheat at mutually agreed price.
Fig 4: Marketing Channels of Wheat in India
Government Procurement
The central government procures on an average 28-29 million tonnes of wheat from the farmers every year (2009-10 to 2014-15). In the year 2012-13, the procurement of the wheat was 38 million tonnes which is a record in the government procurement program. Government procurement ranges between 25-30% of the total production of wheat in India. In 2014-15 wheat procurement stood at 28.02 million tonnes.

Fig 5: Year-wise Procurement of Wheat by the Government Agencies in India

Large wheat surplus states like Punjab, Haryana, Uttar Pradesh, Madhya Pradesh and Rajasthan are the major contributor of wheat in the government procurement system. These five states on an average contribute 95-97% of the total wheat procured by the government of India. Punjab remains largest contributor of wheat, 11 million tonnes annually, followed by Haryana 6.5 million tonnes.

Fig 6: Year-wise Wheat Production vs Government Procurement in India

supply of wheat from major procurement state
Again, Punjab and Haryana are the key states from where the surplus wheat (Govt. procured stocks) moves to other states. The table below shows the quantity of wheat transported to different states from Punjab and Haryana.

Table 3: Movement of Wheat from Punjab and Haryana (Ex-North)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Punjab</td>
<td>9.5</td>
<td>5.8</td>
<td>5.5</td>
<td>7.6</td>
<td>9.4</td>
<td>9.4</td>
<td>8.6</td>
<td>8.9</td>
</tr>
<tr>
<td>Haryana</td>
<td>4.0</td>
<td>1.8</td>
<td>2.7</td>
<td>3.4</td>
<td>4.8</td>
<td>6.4</td>
<td>4.4</td>
<td>6.2</td>
</tr>
</tbody>
</table>

Quantity in Million Tonnes

Supply of Wheat to the Major States
The central government will supply the wheat to various states under various schemes to be distributed to the consumers in India. Apart, the government would also release some quantity of wheat which is sold in the market to the various types of consumers like bulk traders, processors and retailers under Open Market Sale Scheme (OMSS).

In the last two years (2012-13 & 2013-14), the government has sold 6.86 million and 6.11 million tonnes of wheat respectively, under OMSS to various states in the country. Delhi, Haryana, Punjab, Madhya Pradesh, Tamil Nadu, Maharashtra etc. are the major taker of wheat in under this scheme.
Table 4: State-wise Supply of Wheat under OMSS

<table>
<thead>
<tr>
<th>State</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Bengal</td>
<td>57.6</td>
<td>1.9</td>
<td>216.9</td>
<td>242.7</td>
</tr>
<tr>
<td>Delhi</td>
<td>278.0</td>
<td>209.6</td>
<td>754.4</td>
<td>859.9</td>
</tr>
<tr>
<td>Haryana</td>
<td>62.0</td>
<td>59.5</td>
<td>536.4</td>
<td>1142.2</td>
</tr>
<tr>
<td>J &amp; K</td>
<td>81.1</td>
<td>190.8</td>
<td>248.8</td>
<td>222.3</td>
</tr>
<tr>
<td>Punjab</td>
<td>57.8</td>
<td>80.4</td>
<td>339.7</td>
<td>795.8</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>11.7</td>
<td>3.5</td>
<td>340.3</td>
<td>348.0</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>81.1</td>
<td>66.3</td>
<td>318.7</td>
<td>413.1</td>
</tr>
<tr>
<td>Gujarat</td>
<td>28.0</td>
<td>95.7</td>
<td>232.6</td>
<td>208.4</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>112.4</td>
<td>119.7</td>
<td>464.1</td>
<td>389.5</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>4.4</td>
<td>4.4</td>
<td>1541.9</td>
<td>629.4</td>
</tr>
<tr>
<td>Others</td>
<td>381.0</td>
<td>352.3</td>
<td>1873.2</td>
<td>859.5</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1155.0</td>
<td>1184.0</td>
<td>6866.9</td>
<td>6110.8</td>
</tr>
</tbody>
</table>

Quantity in 000 Tonnes

Wheat Demand and Supply Scenario

Table 5: Wheat Demand and Supply Balance-Sheet of India

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<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Harvested</td>
<td>26.4</td>
<td>28</td>
<td>28.15</td>
<td>27.75</td>
<td>28.52</td>
<td>29.1</td>
<td>29.8</td>
<td>29.4</td>
</tr>
<tr>
<td>Beginning Stocks</td>
<td>2</td>
<td>4.5</td>
<td>5.8</td>
<td>13.43</td>
<td>16.19</td>
<td>15.36</td>
<td>19.95</td>
<td>24.2</td>
</tr>
<tr>
<td>Production</td>
<td>69.35</td>
<td>75.81</td>
<td>78.57</td>
<td>80.68</td>
<td>84.27</td>
<td>86.87</td>
<td>94.88</td>
<td>92.46</td>
</tr>
<tr>
<td>Imports</td>
<td>6.72</td>
<td>1.96</td>
<td>0.01</td>
<td>0.29</td>
<td>0.3</td>
<td>0.03</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Supply</td>
<td>78.07</td>
<td>82.27</td>
<td>84.38</td>
<td>94.4</td>
<td>100.76</td>
<td>102.2</td>
<td>114.84</td>
<td>116.68</td>
</tr>
<tr>
<td>Exports</td>
<td>0.09</td>
<td>0.05</td>
<td>0.02</td>
<td>0.06</td>
<td>0.2</td>
<td>0.7</td>
<td>6.5</td>
<td>6</td>
</tr>
<tr>
<td>Total Consumption</td>
<td>73.48</td>
<td>76.42</td>
<td>70.92</td>
<td>78.15</td>
<td>82.48</td>
<td>81.5</td>
<td>84.14</td>
<td>91.86</td>
</tr>
<tr>
<td>Total Demand</td>
<td>73.57</td>
<td>76.47</td>
<td>70.95</td>
<td>78.21</td>
<td>82.68</td>
<td>82.2</td>
<td>90.64</td>
<td>97.86</td>
</tr>
<tr>
<td>End Stocks</td>
<td>4.5</td>
<td>5.8</td>
<td>13.43</td>
<td>16.19</td>
<td>18.09</td>
<td>20</td>
<td>24.2</td>
<td>18.82</td>
</tr>
</tbody>
</table>

Quantity in Million Tonnes, Area in Million Ha
Source: USDA

Demand/Consumption of Wheat

Wheat is used for seed, feed and export purposes. In India around 85.5-86.0 million tonnes of wheat is consumed (average during 2011-12 to 2013-14). Indian farmers will require around 4.25-4.5 million tonnes wheat as seed. The wheat demand for feed purposes has also increased in the recent 3-4 years, as per the USDA estimate Indian feed sector uses 3.5-4.0 million tonnes of wheat annually.

As per the market survey, on an average around 78-80 million tonnes of wheat is consumed within the country in various forms. In this, roller flour mill processes around 13-14 million tonnes of wheat to produce various products like maida, suji/rava/semolina and other bakery flours. At present in India, around 1000-1050 roller flour mills are operating with a total annual installed capacity of 25 million tonnes. The average capacity utilization of these mills is 50-60%.

Atta is largest form in which wheat is consumed in India. As per survey, around 65-66 million tonnes of wheat is consumed as atta.

As per the National Sample Survey Organisation (NSSO) estimate, the current annual consumption of wheat and wheat products in India is 68-69 million tonnes. In this, rural consumption accounts for about 68% of the wheat consumed in India. However, the per capita consumption is almost equal in both urban and rural population, i.e. 4.34 Kg per capita/year and 4.36 Kg capita/year respectively. In the last two consumption estimates (2004-05 and 2009-10), the per capita consumption of wheat and wheat products among the rural consumers has increased by
1.5% whereas in case of urban consumers it has declined by 7%.

**Fig 9: Rural and Urban Consumption of Wheat and Wheat Products in India**

As per the NSSO statistics 2009-10, in terms of the per capita consumption of wheat and wheat products, Rajasthan stands first followed by Haryana, Punjab, Madhya Pradesh and Uttar Pradesh. The average per capita consumption of wheat and wheat products in these are 8.83, 8.37, 7.9, 7.8 and 7.45 kg per month respectively.

Wheat flour or Atta is the largest form in which wheat is consumed in India, among both rural and urban consumers. Atta occupies 95% share in per capita wheat and wheat products consumed in India.

**Major Consumption Centers of Wheat and Wheat Products in India**

In terms of total household consumption of wheat and wheat products, Uttar Pradesh (UP) is the largest market in India. Out of total estimated household consumption demand 63-65 million tonnes of wheat and wheat products, UP alone occupies 28% share followed by Rajasthan, Bihar and Madhya Pradesh (MP) occupying around 11% shares each.

**Fig 10: Major Wheat Consuming States and % Share in Total Consumption**

Apart from wheat flour (Atta), other products like Maida, Semolina/Rawa and other flours mainly consumed in bread and bakery industry occupies around 5% share in total consumption demand of wheat and wheat products in India. These products are processed/manufactured in Roller Flour Mill (RFM).

As per the NSSO consumption estimate, India on an average consumes 2.5-2.75 million tonnes of Maida, Semolina/Rawa and other products annually. This quantity excludes institutional consumption and export demand. Uttar Pradesh, again, is the largest consumer of roller flour mill products, however it terms of per capita consumption in southern states, like Karnataka, Andhra Pradesh and Kerala, are highest among the other consuming states.

**Fig 11: % Share of Top Five Consuming States of Roller Flour Mill Products**

Apart from wheat flour (Atta), other products like Maida, Semolina/Rawa and other flours mainly consumed in bread and bakery industry occupies around 5% share in total consumption demand of wheat and wheat products in India. These products are processed/manufactured in Roller Flour Mill (RFM).

As per the NSSO consumption estimate, India on an average consumes 2.5-2.75 million tonnes of Maida, Semolina/Rawa and other products annually. This quantity excludes institutional consumption and export demand. Uttar Pradesh, again, is the largest consumer of roller flour mill products, however it terms of per capita consumption in southern states, like Karnataka, Andhra Pradesh and Kerala, are highest among the other consuming states.

**Fig 12: State-wise Consumption of Maida, Semolina and Other* Wheat products**

*Others include bread, noodles, sewai and bakery products.
Aroma and texture of the flour are said to be key reasons for using this Chakkis. These Chakki mills are generally smaller in capacity (max 300 kg per hour). Large Atta manufacturers will be having number of Chakki (grinders) to establish their capacity. The segment is largely dominated by the small and unorganized processors. Now, innovation has taken place in this segment some technology providers like Buhler has introduced a high capacity Atta milling plant which is having steel rollers instead of traditional stone rollers.

Roller flour mills are comparatively organized than Atta millers. The capacity of individual roller flour mills varies from 30 tonnes per day to 50 tonnes per day (8 hour operation in a day). Key roller flour milling states, size and average annual wheat consumed is given in the fig.

The average recovery from the roller flour mills is around 97%, in this 56-68% Maida, Semolina/Rawa and resultant Atta 7% each, 23-25% is recovered as bran which is used as cattle feed. The resultant Atta is fine flour compared to the Chakki Atta which is mainly used by restaurants and hotels to make specialty breads like Tandoori Roti, Kulcha and Nan etc. Remaining 2-3% goes as waste which is largely un-recoverable.

Fig 13: State-wise Roller Flour Mills and Annual Consumption of Wheat

Export of Wheat and Wheat Products from India

Wheat is an essential commodity in India, the export of wheat and wheat products are largely controlled by the government. As per the demand and supply scenario, the government will take appropriate decision on wheather to allow export or not. The decision will also have quantum restriction even if the export is allowed.

Since the year 2011-12, India has been producing wheat in bumper quantity, looking at this scenario the government has allowed export of wheat and wheat products from India. The export is allowed through two sources, one export through nominated agencies from the Central Pool Stocks held by Food Corporation of India (FCI) and second through private account mainly the private traders and processors.

Majority of whole wheat is exported through the first channel; nominated agencies (called Central Public Center Unit- CPSU) like MMTC, STC and PEC will invite the export houses to send the wheat through EDI enable prots. In the year 2012-13, 4.24 million tonnes of wheat is exported through the CPSUs.

The government has first allowed export of wheat products like maida, semolina/raw, resultant atta and whole meal atta in the year 2009 after a long ban. The export was allowed with the ceiling of 650,000 tonnes since then upto the year 2013. After this, the government has allowed unrestricted export of wheat products from India till today.

Export of Wheat (Whole Grain)

India has exported 579,000 tonnes, 5,795,000 tonnes and 5,037,000 tonnes of wheat during the year 2011-12, 2012-13 and 2013-14 respectively. Bangladesh is a major export destination during all the years, Korea republic is the second largest export destination during the year 2012-13 and 2013-14. Bangladesh alone imported 30% and 39% of the total wheat exported from India during the year 2012-13 and 2013-14 respectively.

Fig 15: Year-wise Export of Wheat to the Major Countries from India
In India, majority of the wheat exported through EDI enable ports of Gujarat and Andhra Pradesh.

Export of wheat flour is mainly happened during the year 2013 and 2014 (up to June), during this period 308,000 and 135,000 tonnes of wheat flour exported respectively. Indonesia, Medagaskar, UAE, Somalia, USA etc are the major importers of wheat flour from India. Average import of wheat from from India during the year 2013 and 2014 (up to June) is given below.

<table>
<thead>
<tr>
<th>Country</th>
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<tr>
<td>China</td>
<td>5.2</td>
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</tr>
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Table 6: Country-wise Export of Wheat Flour From India

Fig 16: Port-wise Export of Wheat Wheat Flour

Fig 17: State-wise Export of Wheat from India
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Overview of Contract Milling of Wheat in India

What is contract milling of wheat?
In a contract milling arrangement, wheat (from single or multiple origins) is supplied by a company (usually a branded atta marketer) to a third party (the miller) to be milled into atta of specified quality. Quality control norms to be followed by the third party are specified in detail and monitored by the company. The third party also provides packaging of the final product as per specification and dispatch of the same to their specified destinations.

Why is there a need for contract milling?
Contract milling offers three specific advantages to the atta marketer (1) Ability to customize atta to the specific requirement of a particular market (it may involve choosing the right blend of wheat, milling the wheat to a specific fineness and adjusting the moisture levels to suit culinary preferences as well as geographic conditions); (2) Flexibility to upscale or downscale production volumes in line with seasonal variations in demand in the shortest possible time and (3) a cost advantage due to differential labour costs structure.

To the miller, contract milling offers assured processing volumes and thus scale of operations. More importantly, the miller need not invest in procurement of wheat and marketing of atta and thus is immune to price risks and other risks in the trade. The millers nevertheless get a thorough understanding of preferences of consumers of atta of a particular region and the process control needed to get that quality consistently.

Thus, contract milling is a win-win proposition both for the atta marketer as well as the miller.

Market size and growth levers:
It is estimated that the market size of the contract milling of wheat is 1.5 million tons per annum. The main atta marketers involved in this kind of arrangements are ITC Foods (Ashirvad), General Mills (Pillsbury), Shakti Bhog and several private labels of organized retail network. ITC is the leader in this segment with a lion share of one million tons per annum.

Average daily volumes differ based on the marketer’s requirements. It would differ from 500 to 1000 tons and as high as 4000 to 5000 tons. Volumes will be fixed based on the company’s capacities and requirements.

Contract milling is a continuous process and will continue until goodwill is maintained between the parties concerned.

Multi grain atta is gaining popularity as it contains more fibre, protein as it contains cereals, oats, soya, ragi etc., adding more nutritional benefits.

Increasing migration to cities in search of livelihood, nuclear family structure and increasing proportion of women opting for work are pushing people towards convenient based (read time saving) ready to cook products. Increasing purchasing power has increased the access of these products to the consumers. Thus, it is expected that atta- both branded and unbranded- would continue to see a healthy double digit growth in the Indian market in the next five to 10 years. This growth in atta market would spur growth in contract milling too.

(We thank Mr Pramod Kumar, of Sunil Agro Foods Ltd., Bangalore, for his valuable inputs for the article)
How Trading in Wheat Futures Can Get the Market Right

Pallavi Oak, Knowledge Management Group, NCDEX

Policy issues related to food security have once again come into limelight with India backing out from Trade Facilitation Agreement, a signatory deal signed by 160 countries across the world at 9th WTO Ministerial Conference in Bali, Indonesia, last December. India’s opposition to the Bali package and demand to allow developing countries to continue subsidizing and stockpiling food in pursuit of food security objectives is understandable. However, given the paradoxical situation of overflowing granaries and rising food inflation in the country, there is an urgent need to review the mechanism deployed to achieve food security objective. This is quite relevant in case of wheat, which has played important role in directing India’s food management policy evolved against the scarcity and import dependence.

Historically, India’s food policy has involved heavy government intervention in all aspects of the food grain market including pricing, procurement, stocking, transport and marketing. Wheat market also has witnessed similar trend where attractive procurement prices have encouraged farmers to sell their crops to the government, while open-ended nature of the procurement schemes has made government procure the grain at level higher than those warranted by the twin objectives of buffer stocking and public distribution. This has caused huge inventory build-up with the Food Corporation of India (FCI) and other government warehouses, in turn, raising the economic cost incurred in carrying out these activities. The central government reimburses economic cost (net of sales realization) to FCI in the form of food subsidy. This has led to sharp increase in food subsidy bill, which is estimated to touch Rs 92,000 crore in 2013-14.

The government procures more than a third of the total production of wheat cornering more than half of market surplus. The government, thus, assumes near monopolistic position and in turn crowds out private participation in the market. The expanded role of the public distribution system entails higher risk to the government agencies in procuring and distributing food grain to larger segment of the population leaves smaller remainder of the produce for the private sector and increase in price risk from non-cereal farm commodities.

The recent example of risk to wheat economy due to piling up of stocks by the government has been the surge in price inflation for wheat. Excess procurement by the Food Corporation of India and state procurement agencies particularly in Chhattisgarh and Madhya Pradesh created artificial scarcity despite bumper produce of the grains.
Annual inflation in wheat remained in double digit during August 2012 to July 2013 and has averaged around 18% and inflated cost for the wholesale and retail consumer.

The government efforts towards trimming the food stock have been through domestic sale of food grain through open market sale scheme (OMSS) to smaller private traders and bulk consumers such as roller flour mills and allocate stocks for sale through private and state agencies. The modern commodity markets help the government sell stocks through seamless electronic spot exchanges which enable pan-India auction of commodities through an operationally efficient platform at lower transaction cost as against the time consuming paper tendering process. Electronic commodity spot exchanges allow Food Corporation of India to get the best price by reaching out to buyers across the country. Seamless deliveries through commodity exchanges can augment flow of grain in lean season in order to contain inflation and trim reserves.

The government’s procurement of wheat is concentrated in Punjab, Haryana, West Uttar Pradesh and Madhya Pradesh. The traditional procurement zones for wheat have become vulnerable to deceleration in yield, over exploitation of ground water and land degradation due to heavy usage of fertilisers raising risk to steady supplies to the food security programme.

Assuming that food security is a public good, resorting to alternative market-based farmer support programme that would not require direct intervention by the government including private stocks and other producer and processor risk management tools is the need of the hour. It is said that when the markets (consumption and production centres) are widespread and physical movement of commodity is not smooth (inter-state movement restrictions, poor transportation and storage infrastructure), futures trading helps significantly in improvement of the market risk.

**Hedging in Wheat Futures by HAFED**

The Haryana State Cooperative Supply and Marketing Federation Ltd. (HAFED) began using the NCDEX wheat contract after its launch in July 2004 as a standard “short hedger,” against its cash (long) purchases from farmers. HAFED employed “buy low, sell high” strategy, i.e., it took advantage of the substantial carrying charge between the April and May harvest months and December, when it chose to place its short hedges in the deferred month, thus achieving the maximum price for the crop cycle. Ann E. Berg (2007) reports that in 2006-2007, HAFED was able to “lock in” a net profit of Rs. 108 per quintal after deducting storage, interest, VAT, and transportation charges. Hedging in wheat futures enabled HAFED meeting its goal of mitigating its losses that could have been incurred by holding unhedged physical supplies of wheat. Because NCDEX had accredited HAFED’s warehouses for delivery registrations under the wheat contract, HAFED was able to deliver its stored wheat in its own warehouses in satisfaction of its short position, earning storage and avoiding additional logistical expenses. Futures transactions also brought other benefits in the form of availability of auditable records of sales prices (i.e., futures transactions), increased liquidity, and quality assurance (achieved by strict assaying methods by registered warehouses). Hedging in wheat futures proved so successful for HAFED that it developed plans to act as an aggregator and distribute future profits from its hedging operations to its farmer members for the following year.

Trading in futures market can help government cover its hedging needs in case of import of the grain. Although India is self-sufficient in wheat production, a severe drought of the magnitude of 2002-03 which had caused a sharp fall in wheat output can force the country to ship in cereals from the international market. It becomes essential to manage risk through futures as the international price is susceptible to spike if a large consumer like India tends for import. Higher participation in wheat futures can enable hedging of price risk at low transaction cost.
Hedging through futures trade must be explored extensively by the governments and the private sector as one of the instruments to secure against price risk, ensure healthy operations of the welfare schemes and open economy. This is a necessary step to bring about rationality in pricing, contain the food subsidy bill and ‘getting the markets right’, especially when India has become a central pricing centre for wheat, in the wake of global shifting of wheat production and consumption.

Futures markets for commodities can be used as an early warning system for ensuring physical and economic access to sufficient food. Prices for foodgrain with appropriate time lag in the future can provide price signal to the farmers for production decision, and the government’s agencies to prepare their machinery for meeting the foreseeable demand from TPDS and open market vis-à-vis expected supplies. The early warning of short supply provided by futures prices can help the government initiate input support (seed, fertiliser, drought relief) to domestic farm sector as well as tender for overseas supply in advance.

Trading in wheat futures can be used to hedge price risk for stocks sold in domestic and international market to cover for the complete economic cost of procurement to a insure margin. HAFED’s experience of trading in wheat futures can prove this point.

1 The TFA rule mandates to cap agriculture subsidies to farmers in developing countries at 10% of the total value of agricultural production based on 1986-88 prices and puts India at risk of violating the WTO rules. The economic cost of foodgrains comprises of MSP (and central bonus if applicable), procurement incidentals and the cost of distribution.
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Fortification of Wheat Flour with Millets

Dr Dayakar Rao, G Bhargavi and J V Patil
Directorate of Sorghum Research, Hyderabad

Introduction
Fortification is the practice of adding essential vitamins and minerals (e.g. iron, vitamin A, folic acid) to staple foods to improve their nutritional content. It is a safe, effective way to improve public health that has been used around the world since the 1920s. Commonly fortified foods include staple products such as wheat flour, maize flour sugar and rice.

Micronutrient deficiency, also known as “hidden hunger,” is an aggravating factor for health status and quality of life, affecting more than half of the world's population. Food fortification is practically applicable and has drawn considerable attention from governmental and health agencies. The success of food fortification programs lies in the selection of vehicle and fortificant. Wheat flour fortification with minerals, phytochemicals seems to have a greater influence compared to many other vehicles in the India, where the wheat flour is mainly consumed as a dietary staple to meet energy requirements. The fortificants added should not impart undesirable characteristics to the food, such as changes in color, taste, smell, and texture. Atmospheric conditions and lack of modern storage facilities for fortified flours demand more consideration than stability and acceptability issues. Fortification should not unduly curtail the shelf life of the fortified whole wheat flour. Bioavailability of fortified flour has long been debated and highlights the fact that use of novel iron sources in the presence of phytic acid in wheat flour could be a better choice for fortification.

In recent years, there has been growing demand for functional bakery products partly due to consumer preference because they are generally perceived as safer & healthier than their synthetic counterparts. In this respect, phytochemicals have received increased attention because of their biological significance and potential positive health effects. Bread is the major bakery product and consumed worldwide in relatively large amounts. Functional breads formulated with bioactive compounds are becoming important in the bakery industry, and various ingredients are being used to improve the health benefits of the final product. Many functional ingredients are available for bakery applications, and many producers have begun to formulate breads with soy isoflavones, β-glycan’s, conjugated linoleic acid, and omega-3 fatty acids. In this chapter, phytochemicals that contribute to the health benefits of bread and their use in the bread making process are reviewed.

Vitamin B12 deficiency is a common clinical condition, sometimes leading to severe hematologic and neurologic diseases. Screening for vitamin B12 deficiency is indicated in patients with relevant signs, such as anaemia, neuropathy, or cognitive impairment. Since folic acid fortification started, the concern of masking anaemia and macrocytosis due to vitamin B12 deficiency, leading to neurologic disease, has emerged. Oral treatment with vitamin B12 is effective even at low doses in most cases of food-bound vitamin B12 malabsorption, and it has been advocated as a suitable means to prevent B12 deficiencies. Fortification with vitamin B12 is expected to reduce the vitamin deficiency-related diseases and prevent the folic acid masking effect.

Millet, being less expensive compared to the other cereals and the staples for the poorer sections of population could be the choice of fortification with micronutrients such as zinc and Iron. In view of this some millet like Sorghum and finger millets are widely grown and consumed in southern India, was explored as a vehicle for fortification. It was estimated that millet flours fortified with iron might
be beneficial in combating iron deficiency. In this investigation, two products were also prepared from using finger millet and sorghum flours fortified with iron and ethylene diamine tetraacetic acid and stored for up to 60 days were evaluated for sensory quality and texture. Fortification did not cause any significant change in the hardness of dumpling or the shearing effect of the roti prepared from either of the millet flours. There was no significant effect of the fortificant on the texture and aroma of the products prepared from the fortified flours up to a period of 60 days. Finger millet and sorghum flours seem to be suitable as vehicles for fortification with iron.

**Why should atta be fortified?**
When vitamins and minerals are added to wheat, sorghum, maize & rice flour, commonly eaten foods become more nutritious. Consequently consumers improve their health without changing food habits. The extra nutrition by (fortifying atta) helps people become smarter, stronger & healthier like, improved health, increased productivity and economic progress. Fortification of grain foods was found to be an effective strategy that can be used to overcome nutrient deficiencies. Micronutrient deficiencies, especially of vitamin A, iron, iodine, and zinc, are widely prevalent in both developing as well as some developed countries. However, iron deficiency is a major public health problem in developing countries, it affects up to 50% of infants, children, and women of child-bearing age in poorer populations of Asia, Africa and Latin America.

**What should it be fortified with?**
Protein malnutrition a serious problem of people whose diets consists mainly of cereal & starchy foods, has around keen interest in fortifying flours & other products with protein rich additives.

Millet and sorghum flours can be blended with flour to produce bakery products. One of the major aspects of fortification is to prevent protein energy malnutrition. As protein content differs greatly in dry flours and of more common cereals. It is said that the protein content of wheat flour is similar to those of spelt and quinoa, but it is higher in other flour of cereals like sorghum, barley, finger millet developed in India.

The nutritional value of flours can be improved by making composite flours with non-wheat cereals or supplementing its flour with protein rich sources such as millet flours. Sorghum can be used as an alternative to cereals in human diet because its nutritional value and high quality proteins are enhanced. The amino acid composition is often used to define the nutritional quality of a protein. Tryptophan is the least represented amino acid in the protein of cereals, which are an essential part of daily nutrition.

Nutritional deficiencies are of major concern to policymakers in developing countries. Growing populations, hunger, poverty, and lack of nutrition education are major hindrances in eradicating these deficiencies. Iron deficiency alone affects 2 billion people throughout the world, and deficiencies in zinc, iodine, vitamin A, and calcium are other major health issues. Multiple strategies are available to overcome this situation, including food diversification, supplementation, fortification, and production of crops with enhanced levels of these micronutrients. Among these strategies, fortification is the most feasible and cost-effective approach, especially in developing countries. Mineral fortification of whole wheat flour is a suitable choice for those countries in which communities rely on wheat as a dietary staple. However, the choices of fortificants and their levels are major determinants in assessing the success of these programs. Ferrous sulfate and sodium iron ethylene diamine tetra acetate are iron fortificants with the highest bioavailability.

An increased consumer desire for a healthy lifestyle has resulted in demands from the bakery industry for breads containing functional compounds. There is an immediate requirement for the food industry to prepare healthy bakery products to satisfy consumers' needs. New plant-derived natural ingredients or processing steps are needed to develop breads with similar qualities as those of white ones. As the number of available phytochemicals increases, the incorporation of these functional ingredients into bakery foods will become easier. Many phytochemicals exist for bakery applications, and producers have started formulating breads with soy isoflavones, β-glucans, conjugated linoleic acid, and n-3 fatty acids. Research is needed to evaluate the effects of the phytochemical ingredients on the functional and nutritional properties of bread.

Vitamin B12 deficiency has been reported as a frequent condition in elderly people. Major causes of low vitamin B12 status are malabsorption syndromes (food-bound vitamin B12 malabsorption, pernicious anemia, chronic
atrophic gastritis, and celiac sprue). Vitamin B12 deficien-
cy can lead to hematologic (e.g., megaloblastic anemia),
neurologic (e.g., peripheral neuropathy), and psychiatric
(e.g., dementia and depression) disorders. The replace-
ment therapy with vitamin B12 aims to treat clinical
disorders related to vitamin B12 deficiency. Very low oral
doses of this vitamin have been shown to be efficient in
increasing the serum vitamin B12 levels in elderly patients
with food-bound vitamin B12 malabsorption (the most
frequent etiology among elderly people). In the setting
of national programs of flour fortification with low doses
of folic acid, a significant reduction in the incidence of
neural tube defects has been shown, but the main concern
related to a high daily consumption of folic acid (beyond 1
mg/day) is a possible masking of the anemia and macro-
cytosis due to vitamin B12 deficiency, which could con-
sequently lead to neurological diseases. Flour fortification
with both folic acid and vitamin B12 has been proposed to
avoid this risk.

The world health organisation issued a consumers state-
ment enclosing fortification of atta like wheat with iron,
folic acid, vitamin B12, vit-A, thiamine, riboflavin, niacin & zinc. Some of these are already a part of Ameri-
can diet since 1941 which helps to eradicate beriberi & pellagra.

Improved nutrition prevents diseases, strengthens immune
system, productivity & cognitive development. Also the
number of children born with neural tube defects such as
spina bifida declines when atta is fortified with folic acid
& B vitamin. One Meta analysis showed that fortifying
wheat flour with folic acid reduced the incidence of these
birth defects by an average of 46.

How fortification of wheat atta with millets atta en-
able improvement in the nutritional levels?
It has been established that along with fortified wheat
flour, millet flour like sorghum and pearl millet also seems
to be a satisfactory candidate for fortification with zinc,
and so can be exploited to address zinc deficiency. On the
other hand, heat processing of Fortified Millet Flour im-
proved the bio accessibility of iron from both unfortified
and fortified flour. Fortification with iron also did not af-
fact the bio accessibility of the native zinc from the flour.
Furthermore, double fortification of Millet Flour with fer-
rous fumarate, zinc stearate, and EDTA did not negatively
alter the sensory quality of the products prepared from
them. In addition, the shelf-life of the fortified flours was
also satisfactory up to a period of 60 d, as indicated by the
moisture and free fatty acid contents in the fortified flours.
Therefore, it can be said that fortification of millet flours
is a technique to enrich them with micronutrients, such as
microelements and vitamins, to improve their nutritional
quality.

Fortification with vitamins and minerals is one of the most
effective methods to improve health and prevent nutri-
tional deficiencies according to new studies.

Fortified foods are nothing new. Iodine was first added
to salt in Michigan in 1924 in order to help reduce the
prevalence of goitre, which had reached an alarming rate
of 47% in that state. The measure worked so well that it
led to the voluntary iodization of the product for the entire
country. It also paved the way for a cascade of similar,
mandatory approaches. Brain-and-skin degenerating pel-
lagra was almost completely eradicated within about a
decade after breads and grains were enriched with niacin,
thiamine, riboflavin and iron in 1943.

In 1998, the U.S. Food and Drug Administration made
it mandatory to add folic acid to enriched grains such as
breads and cereals with the goal of reducing neural-tube
defects in babies. Between then and 2004, the number
of infants born with neural-tube defects went down by
25%. Gone are the days when food aid only consisted of
delivering sacks of flour, grain and other basic ingredients
to developing and impoverished nations. Today’s aid ini-
tiatives are also supporting the fortification of foods with
essential nutrients, while building the capacity of local
businesses and the wider economy.

Malnutrition remains a huge challenge throughout the
developing world. The World Food Programme estimates
that some 870 million people around the world do not
have enough food to eat and 98% of these live in develop-
ing countries. UNICEF adds that malnutrition in develop-
ing countries contributes to half of child deaths. Adding
essential vitamins and minerals to everyday foods like
flour and salt can reduce the incidence of life-threatening
diseases like malaria and diarrhoeal disease and costs
just a few pennies per person per year. More than a dozen governments in various countries have incorporated food fortification into policy and legislation. A number of initiatives are helping local food producers to meet national fortification standards with the added benefit of boosting the prospects of smaller businesses by providing reliable access to affordable blends of vitamins and minerals known as premix.

What is the incremental cost of fortification?
It was estimated by Copenhagen Consensus that every $1 spent on fortification results in $9 in benefits to the economy. An initial investment is required to purchase both equipment and the vitamin and mineral premix, but overall the costs of fortification are extremely low. Even when all program costs are passed onto consumers, the price increase is roughly 1-2%, less than normal price variation.

Although the technical problems to fortify a food with a specific micronutrient can be overcome, it may take years of trials to adjust for micronutrient levels or physical qualities and taste, all of which have a considerable cost. Even when the technical difficulties have been overcome, fortification programmes are not cost-free. The costs associated with the food fortification process can limit the implementation and effectiveness of food fortification programmes. Careful analysis of these issues prior to taking any decision to launch or expand a programme is needed. While start-up costs are often available to governments from external sources such as donors, foundations and industry, this can seriously distort the realistic analysis of the purchasing power of the expected beneficiaries as well as the recurrent costs involved in creating and maintaining the demand for these products. While various schemes (government subsidy, shifting costs to better-off social groups, etc.) have been tried in fortification programmes, these tend to be unsustainable when not demand-driven. Realistic government decisions on these issues must be based on the analysis of recurrent follow-up programme costs.

Is atta from ‘multigrain’ also a form of fortification? If so, is it not simpler to do that? Moreover, is it not easier to communicate to consumers?
Multi Grain Atta is a healthy blend of six natural grains like whole wheat, maize, oats, soy, Bengal gram and barley. It serves as a good source of fibers with proteins and essential nutrients. It contains essential nutrients like iron, folic acid and zinc.

Considering the current lifestyle patterns, these nutrients are essential. So, these are fortified with essential nutrients for healthy growth & development while a diet high in fibre helps maintain a healthy digestive system. Iron is an important nutrient for stamina and it has folic acid for healthy food formation.

Simply having fortified products on the market does not promise that consumers will use the products or that businesses will continue to promote them. Carefully crafted and strategically implemented behaviour-change communication can inform and motivate consumers to purchase and use the products appropriately, and in turn, can motivate food companies, program managers, and policy makers to participate in the marketing of these products. Audience-specific marketing strategies can ensure that the same fortified product reaches every person who would benefit from it.

Are there any regulation and standards for fortification?
At one time, the addition of chalk to bread was officially recognised as adulteration and banned by law: today, in the name of fortification, it is mandatory in almost all.

The Indian Standard was adopted by the Indian Standards Institution on 28 May 1984, after the draft finalized by the Nutrition Sectional Committee had been approved by the Agricultural and Food Products Division Council.

Indian standards for wheat atta:

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</tbody>
</table>
Fortification as part of a country’s nutrition strategy is supported by global organizations such as UNICEF, the World Health Organization (WHO), the U.S. Centers for Disease Control and Prevention (CDC), the Global Alliance for Improved Nutrition (GAIN), and the Micronutrient Initiative (MI).

If the level of iron, thiamine or nicotinic acid / niacinamide present in the atta meets the minimum level prescribed by the regulations for that nutrient, then fortification with that nutrient is not required. If produced flour does not meet standards set out in the Food and Act, it is termed to be “unfit for human consumption”.

Therefore, it can be concluded that supplementation of flour like wheat and millet flours with natural food products to enhance their nutritive value can be promising and with high cost-effectiveness compared with fortification by chemical synthetic nutrients.

References:
Fortification of Atta

Sarah Zimmerman, Communications Coordinator, Food Fortification Initiative-USA

Atta, a key ingredient in India’s popular flat-breads, may also be a key instrument in addressing one of India’s primary health concerns. Iron deficiency is a leading cause of anemia which is critically high in India. Fortunately, industrially milled atta can be fortified to help prevent iron deficiency and still produce the chapatti, roti, naan, and puri that people want.

Iron deficiency is not obvious to observe, yet its consequences can be devastating. In children, iron deficiency limits physical growth and mental development, and these losses are never recovered. Children who do not reach their full physical and academic potential will have limited future opportunities. In people of all ages, iron deficiency causes lethargy and lower productivity. It can also contribute to maternal mortality.

Based on India’s 2005-2006 National Family Health Survey, the national prevalence of anemia was 69.5% among children 6-59 months old and 55.3% among women ages 15-49 years old. Prevalence higher than 40% among these groups is considered a “severe public health problem” according to the World Health Organization (WHO).

The typical Indian diet, which is usually low in dietary iron, probably contributes to the high anemia rates. The best natural source of iron is animal foods, but many Indians do not eat animal foods due to personal beliefs and the high cost.

In addition, some commonly eaten foods keep people from absorbing and using iron in their food. For example, the phytates in several cereal grains and beans inhibit iron absorption and prevent the iron from being beneficial. Likewise, tannins in tea and certain polyphenols in cereals and legumes limit a person’s iron absorption.1

In wheat, phytates are in the outer layers of the grain. These layers are generally removed in milling for low

One proposed solution for improving nutrition is to make atta with multiple grains rather than only wheat.
extraction flours such as maida. Atta, however, is high extraction flour that retains more of the wheat’s outer layers, and consequently more of the phytates which inhibit iron absorption.

One proposed solution for improving nutrition is to make atta with multiple grains rather than only wheat. While this may have other benefits, it is not likely to improve the population’s iron absorption because the other grains may also be high in phytates and polyphenols.

The simplest solution is to fortify atta flour in commercial chakki mills with sodium iron EDTA (NaFeEDTA). For high extraction flours such as atta, this is the only iron compound recommended by the WHO and other international agencies. The Ethylenediaminetetraacetate (EDTA) component enhances absorption of both the iron that is in foods naturally and the iron compound used in fortification. A draft national standard has been developed by the Government of India to outline which nutrients are allowed for wheat flour fortification in India. Sodium iron EDTA is among the iron compounds permitted for use.

One advantage to fortifying flour is that it does not require consumers to change their behaviors. Because people in many parts of India already consume foods made with atta, adding sodium iron EDTA to atta would improve their iron intake and absorption without requiring them to remember to take a supplement regularly.

The main concern about fortification is its cost, and sodium iron EDTA is more expensive than other iron compounds. Yet fortifying atta with any other iron compound is wasteful as it is not likely to have a health impact. Using sodium iron EDTA in atta flour is much more practical than fortifying flour with an iron compound that cannot be expected to make a difference in people’s health.

The ongoing cost to fortify with sodium iron EDTA depends on how much of this iron compound is needed per metric ton of flour. The amount to add depends on the population’s average consumption of foods made with wheat flour. In Indian states where foods made with atta are widely consumed, the amount of iron needed per metric ton of flour will be low, and that will help keep the cost down.

Fortification’s cost is also affected by the number and concentration of nutrients included. Since anemia can be caused by several nutritional deficiencies, not just iron deficiency, the Food Fortification Initiative (FFI; formerly the Flour Fortification Initiative) recommends fortifying grains with a combination of nutrients in countries. This is especially important in countries like India where anemia prevalence is high. For example, efficiencies of folic acid, zinc, and vitamin B12 can also lead to anemia. These can all be added to atta along with sodium iron EDTA.

The combination of vitamins and minerals added to flour in the milling process is called premix. The Global Alliance for Improved Nutrition (GAIN) has a premix facility to competitively procure vitamin and mineral premix from suppliers with proven quality systems and processes. In August 2014, the estimated cost of premix with sodium iron EDTA, folic acid, zinc, and vitamin B12 was US$ 6.71 per kilogram of premix. This equates to a premix cost of US$ 2.35 per metric ton of atta. The estimate is based on the following addition rates:

- 20 parts per million iron as sodium iron EDTA
- 1.3 parts per million folic acid (vitamin B9)
- 0.01 parts per million vitamin B12
- 80 parts per million zinc

The amounts for nutrients are based on WHO recommendations for high extraction flour for populations with an average wheat consumption between 150 and 300 grams per person per day. FFI recommends that millers seek bids from multiple vendors for premix. Consider costs for shipping, customs fees, and taxes in making a decision about which premix supplier to use.

In India, individual states can determine the levels of nutrients to be included in industrially milled flour. Each state can also specify which kind of iron to use. FFI, which is a partnership of public, private, and civic sector groups working to accelerate grain fortification globally, can help states determine appropriate standards for their population.

WHO recommendations include adding vitamin A to wheat flour, if other foods are not effectively fortified with this essential nutrient. Adding vitamin A to flour,
However, makes fortification much more expensive. In India where cooking oil is used regularly in food production, it is probably more logical to fortify cooking oil with vitamin A.

In addition to cost considerations, the potential impact on atta’s shelf life is a concern regarding fortification. The fats in whole-wheat flour such as atta are prone to oxidation, and this eventually causes rancidity. Production and distribution for atta flour has to be managed well, regardless of whether the product is fortified.

Some types of iron commonly used in fortification, in particular ferrous sulfate, can further diminish the shelf life of atta. In contrast, sodium iron EDTA does not provoke fat oxidation, so it does not affect atta’s shelf life.2

It may be tempting to fortify atta with ferrous fumarate because this iron compound also does not enhance fat oxidation. However, ferrous fumarate does not have the EDTA component which helps people absorb iron, and it would not be expected to have a health impact when used in atta.2

Food fortification is gaining momentum in India, though much of the implementation is in pilot projects. The government’s five-year plans to improve nutrition have recommended using fortified foods in the Integrated Child Development Services (IDCS), Mid-Day Meal (MDM), and Public Distribution System (PDS).

Beneficiaries of government nutrition schemes, however, are not the only groups who need improved nutrition. In India, more affluent people are also likely to avoid animal foods and consume cereals that are high in phytates, along with other foods that inhibit iron absorption. A comprehensive fortification strategy that requires the use of sodium iron EDTA in atta is the best solution for distributing the health benefits of fortification throughout the entire population.

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Noodles or Pasta, an Italian traditional food is made with T.aestivum wheat flour or T.durum semolina. These days Noodles/Pasta are becoming popular globally which comes in different varieties and in attractive shapes. Today the amount of wheat flour used for noodle processing in Asian countries account for more than 40% of the flour consumed.

Each noodle or Pasta type requires its own specific flour quality criteria. Generally the flour protein content influences the textural and cooking properties of Noodles/Pasta. To process Noodles/Pasta of desired quality, wheat flour with higher protein content is essential. Apart from this, Noodle/Pasta is considered as a potential vehicle for micronutrient fortification and can be made enriched, supplemented and fortified. These days all varieties of wheat flour / Semolina do not meet the requirements for Noodle/Pasta processing. Hence in recent years, several ingredients and additives have been developed and are being used to improve the quality of Noodle/Pasta as well as to enhance nutrition of it.

Various types of additives such as monoglycerides, salt, lipase, carbonates, phosphates etc improves the quality of the Noodle/Pasta. Addition of emulsifiers is expected to reduce the stickiness of pasta and addition of hydrocolloids or gums strengthens the dough by interacting with starch and protein complex of wheat flour. Addition of mono and diglycerides contribute to the formation of certain chemical connections which lead to elasticity of the dough. Oxidizing agents strengthens the gluten structure by oxidizing sulphhydryl groups to disulphide groups. Anti oxidants prolong the preservation period of food by protecting against oxidation. Addition of phosphates yields the highest values of expansion ratio.

Both endogenous and exogenous enzymes play an important role in quality of Noodle/Pasta. Addition of lipase extends the shelf life and keeps the characteristic yellow colour over time. Combination of lipase and lipoxygenase makes boiled noodles or pasta firmer, smoother and less sticky resulting in easier disentanglement and improved eating quality. Addition of Xylanase also improves the strand quality and expansion ratio.

PD Navkar has designed a range of flour improvers suitable for noodle or pasta processing. P-N 100, P-N 200, P-N 300 and Wonderzyme 100 are range of Noodle/Pasta improvers. These products are blend of highly active enzyme complex with balanced blend of flour treating agents. Use of these improvers eases the extrusion and sheeting process. Improvers also help in firm gluten network formation during dough development and gives good texture due to interaction with starch and protein matrix of wheat flour. Also helps in increased water absorption during cooking yielding more cooked weight and less starch leach out. It also improves the strand quality, making it more firm and less sticky. These improvers are designed to enhance the quality of the Noodles/Pasta.
Wheat Straw as Feed for Livestock: Availability, Nutritional Variability and Quality Improvement

A K Misra, Head of Division, Plant Animal Relationship Division, Indian Grassland and Fodder Research Institute, Jhansi

**Introduction**

Livestock plays a vital role in rural life and economy even today. In fact, animal husbandry and agriculture are twin occupations, which are practiced by the rural households since ancient times. India has a livestock population of over 500 million (20% of the world's total), more than half of which is cattle, forming the backbone of Indian agriculture. It provides employment opportunities, asset creation, coping mechanism against crop failure and social and financial security to the rural masses. Crop residues and by products comprise the main feeds accounting for 40% of the total consumption of large ruminants. Among the crop residues, the wheat straw and rice straw are two main crop residues being used for livestock feeding in various parts of the country. In the Northern part of the country, wheat straw (bhusa) is more intensively utilized, while feeding paddy straw is common in Eastern and Southern regions and part of the Western region, particularly in coastal areas.

**Uses of Wheat Straw**

In India and other Asian counties major quantity of wheat straw is being utilized for the livestock feeding purpose. Statistics show that, excluding grazing, dry roughage - mainly wheat and rice straws - constitutes over 50 per cent of the total forage fed to cattle and buffaloes in India. However, with advancement in technological development and growing concern with environment, some industrial uses of crop residue have also emerged. The wheat straw pulp is also getting attention for paper sheet manufacturing. Recently the automobile industry successfully developed the reinforced plastic from the wheat straw (http://www.autonewscast.com/2009/11/11/ford-teams-up-to-develop-wheat-straw-reinforced-plastic-new-biomaterial-debuts-in-2010-ford-flex/). Besides this, many other possible composite products can be made using wheat fibers including structural (using thermosetting resins) and nonstructural (using either a thermosetting or thermoplastic resin) materials, geotextiles and molded products. The properties of wheat fibers can also be modified through physical and chemical technologies to improve performance of the final composite. In USA, cellulosic materials are being considered for ethanol production and this may offer a solution to some of the recent environmental, economic, and energy problems facing agricultural sector in USA. So with advancement of the technology, it is likely that more straw will be diverted for industrial
use rather being fed to livestock only. This phenomenon would greatly affect the economics and the productivity of livestock production systems solely based on crop residues particularly in Indo-Gangetic plains under wheat and rice system.

Wheat Straw Availability
In India, wheat is grown primarily under rice (Oriza sativa)–wheat (Triticum aestivum) cropping system in the Plains. The share of wheat in total food grain production in India is around 35.5 percent and share in area is about 21.8 percent of the total area under food grains and its straw will remain the major component of feed for ruminants in almost all small scale crop livestock systems prevailing throughout Asia.

As per IGFRI estimates, at present 112 million tons of wheat straw is estimated to be available in the country and in the next decade (Year 2020) this quantity will increase up to 120 million tonnes, registering a growth of 6 percent. The estimated quantity of wheat straw availability (million tons) for the period 2010 to 2020 among the states, will be maximum in UP (27.15 to 28.60), followed by Punjab (15.76 to 16.52), Haryana (11.26 to 11.10), MP (7.56 to 7.96) and Bihar (5.12 to 5.48). These six states will contribute more than 94 percent quantity in wheat straw pool of the country.

Nature and Quality of Wheat Straw
Wheat straw is the potential energy feeds for ruminants because of high cellulose and hemicellulose content. But the energy in the cellulose and hemicellulose is only partly available to animals, because of poor digestibility due to inhibitory elements like lignin in the straw. The wheat straw is composed of very complex polysaccharides bound with lignin. Other components include cutin, waxes and minerals etc. The structural cell wall constituents are mainly polymeric in nature. These polymeric structures can be characterized by their mechanical, morphological, physical, and chemical properties as well as composition, each of which influences digestibility and digestion rate by bacterial and fungal enzymes. Chemical analysis only measures the contents of cell wall constituents. Composition of monomers of cellulose, pectin’s and lignin does not provide information on the degree of polymerization, branching, crystallinity, encrustment of polysaccharides and phenols. The composition of cell walls of wheat straw is variable. Much of the variation may be due to differences in the proportions of plant morphological fractions like nodes, internodes and leaves (blades and sheaths), rather than differences in cell wall composition. The relative proportions of these fractions vary with species, stage of maturity, soil and climate conditions. These factors altogether are responsible for governing the voluntary intake, nutrient composition and utilization of straw. In a study of IGFRI, a wider varietal variation in chemical composition has been observed in wheat straw. The protein content varied from 2.2 to 4.0%, organic matter from 90-96%, NDF from 64-82%, ADF, cellulose from 21-34%, hemicellulose from 33-46% and lignin from 8-10%. Variation in chemical constituents arising mainly due the morphological differences in the plant also affected the digestibility of the straw. The straw dry matter digestibility (NBDMD) of various wheat cultivars grown in different regions varied from 37 to 55 percent. The cell wall lignification is recognized as a prime cause of declines in digestibility and often, poor correlations have been obtained between lignin content and digestibility (Pierce, 1984). The degree of polymerization of lignin is dependent on the content of coniferyl, sinapyl and P coumaryl alcohols which are transformed in to lignin by a complex dehydrogenative polymerization process. The extent of polymerization process determines the degree of resistance of straw fibre against the microbial degradation. The major part of the protein is associated with the cell walls. Cell wall proteins are covalently bonded with polysaccharides. In wheat straw protein lignin linkages are observed. Cell wall proteins have in general low digestibility. Thus wheat straw has insufficient CP for efficient
rumen fermentation (< 9 percent of DM). The high fiber content or cell wall content (NDF) of wheat straw are negatively correlated with voluntary intake, rate of organic matter fermentation, microbial cell yield per unit organic matter fermented. The NDF content and its digestibility varies within the plant fraction and the NDF of leaf sheath and leaf blade origin is more digestible than the stem portion. The International Feed Resources Group in Scotland tested up to 100 varieties of grain from wheat, barley and oats. The quality of barley and wheat in particularly showed wide variations. In fact the variability was such that groups of cattle grew 300 g/d more from consuming one variety of straw than another (Orskov, 1979). Variation in straw quality arising among different wheat cultivars being grown in country may be attributed to these factors. Calcium content of wheat straw may vary from 0.59 to 0.82% and contained required level for dairy animals. However, the straw is deficient in P and Mg as compared to required levels of 0.22 and 0.20%. There was a large variation in Cu (4.40 to 9.79 ppm) and Zn (12.20 to 18.36 ppm) contents of wheat straw. Cu and Zn are at lower levels whereas; iron concentrations were many folds higher than the suggested requirement of 50-100 ppm.

Quality Improvement of Wheat Straw
Numerous methods of physical, chemical, biological treatment have been worldwide researched and developed in order to improve the utilization of straw and other fibrous by-products as feed for ruminants. Physical and biological treatments of roughage have received an appreciable amount of research, but no practical method has been successfully designed due to difficulties in the development of useful and economical treatment processes. Wheat straw having low crude protein content coupled with high cell wall constituents can not even support the maintenance requirements of adult ruminants. The concept of increasing the nitrogen content and nutritive value of low-protein roughages like cereal straw, stovers and other crop residues by means of urea and ammonia treatment is more than a century old and has been researched and tested in the developed and developing world during the past 50 years. The basic principle of the process implies that wheat straw and other crop residues are deficient in N content and as a result their microbial digestion in rumen is affected, as the N is most important nutrient for microbial growth and activity. Urea treatment of wheat straw would increase its N content resulting into enhanced microbial activity and ruminal digestion of the straw. In addition, urea treatment also exerts its effect on lignocellulose complex, wherein the lignin forms the complex with cellulose, thus preventing its microbial digestion. Urea also acts as preservative and application of urea solution on the straw and subsequent storage of treated straw would ensure the proper unspoiled storage.

The use of a cheap source of nitrogen such as urea to improve the nitrogen content of such roughages makes a promising alternative to improve the nutritive value of straw; its application in the field has been very limited in India. Various factors contributed to the lack of impact, most notably the difficulty by farmers to carry out the technical job of urea treatment unaided and the extra work of treatment. Therefore, greater importance is attached for refinement of this technique within the resource constraints of the farmers.

Reference

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Health and Nutritional Benefits of Wheat Germ and Wheat Bran

Dr Hari Priya, Assistant Professor,
Department of Food Science and Technology, Pondicherry University

Health is a fundamental human right and a worldwide social goal. It encompasses all humans disregard of age. Geographical conditions, culture, economic status and lifestyle of people have foremost impact on their health. Needless to say that ‘Food’ is a fundamental need in determining the very existence of living; it also plays a leading role in shaping the health, both physical and mental; of people around the world across time and space. The cultural evolution of human race has been parallel with the style of consumption of food with perfect matching with the geographical conditions and life style of the people. We have now arrived at a time that the food style of the people is not in conformity to the accustomed geographical or cultural conditions. Rapid changes in diets and lifestyles that have occurred with industrialization, urbanization, economic improvement and market globalization have been accelerating since the past decade. This dynamics has a significant impact on the health and nutritional status of populations, particularly in developing countries and in countries in transition.

Changes in the world food economy are reflected in shifting dietary patterns, for example, increased consumption of energy-dense diets high in fat, particularly saturated fat and low in unrefined carbohydrates. These patterns are pooled with a decline in energy expenditure that is associated with a sedentary lifestyle like motorized transport, labour-saving devices in the home, the phasing out of physically demanding manual tasks in the workplace and leisure occasion that is preponderantly devoted to physically undemanding pastimes. Poor food habits and sedentary hedonistic lifestyle have resulted in the perpetuation of diseases like obesity, diabetes mellitus and Cardio Vascular Diseases [CVD]. If this is the scenario amidst affluent population, malnutrition and low immunity- perpetuating secondary diseases are abounding with the poor of the population. These increasingly significant causes of disability and premature death in both developing and newly developed countries, place additional burdens on already overtaxed national health budgets.

Diabetes affects millions of people. Worldwide, 3.2 million deaths are attributable to diabetes every year. At least one in ten deaths among adults between 35 and 64 years old is attributable to diabetes. Various reports confine that the global prevalence of Type 2 diabetes is expected to double in the period 2000 to 2025 and may reach a level of almost 30 million people, that is, 5.6 per cent of total global population by the year 2025. This year alone more than 274,000 people will die of Type 2 diabetes, making it the sixth leading cause of death by disease. Each day over 4,400 people in India are diagnosed with this chronic life debilitating, expansive and pro-aging disease.

Heart disease has been one of the leading causes of death globally for the past 80 years and is a major cause of disability. Around 80 per cent of these deaths occurred in Low and Middle Income Countries (LMIC). If appropriate action is not taken, by 2015, an estimated 20 million people
will die from cardiovascular disease every year, mainly from heart attacks and strokes.

Of the 10.7 million deaths from cardiovascular disease every year in India, 4.2 million are due to ischemic heart disease, 2.5 million due to cerebrovascular disease, and an additional 3.9 million due to hypertensive and other heart conditions. As well, at least 20 million people survive heart attacks and strokes every year, a significant proportion of them requiring costly clinical care, which puts a huge burden on long-term care resources. CVD affects people in their mid-life years, undermining the socioeconomic development, not only of affected individuals, but also families and nations. Lower socio economic groups generally have a greater prevalence of risk factors, diseases and mortality in developed countries, and a similar pattern is emerging as the CVD epidemic matures in developing countries and in India, hyperlipidemia has been the chief precipitating factor in CVDs.

Hyperlipidemia is an excess of lipids, largely cholesterol and triglycerides, in the blood. It is also called hyperlipoproteinemia because these fatty substances travel in the blood attached to proteins as lipoproteins. The best-known lipoproteins are Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL). Excess LDL cholesterol contributes to the blockage of arteries, which eventually leads to ‘heart attack’.

In contrast, the lower the level of HDL cholesterol, the greater is the risk of coronary heart disease. As a result, HDL cholesterol is commonly referred to as the “good” cholesterol. Low HDL cholesterol levels are typically accompanied by an increase in blood triglyceride levels. Studies have shown that high triglyceride levels are associated with an increased risk of coronary heart disease.

Thus in India, as narrated afore, we have taken cognizance of two major disease conditions: Diabetes and CVD which is widely spread. There arises a contingency to address all afore narrated disease conditions in an integrated approach by food science and nutrition and social commitment. While the former forms the basis of the present investigation, the latter vests with the Government and Civil Societies.

In such a context, there arises an essentiality for addressing the entire gamut of issue through one single medium ‘Dietary modification’. Dietary modification plays an immense task in prevention and treatment strategies for these disease conditions. Several antioxidant and nutrient rich foods have been identified in ameliorating the conditions associated with the scourge and the role of wheat have been highlighted in many supplementation studies conducted world over and it can make a major factor in the ‘dietary modification’ discussed afore. But the proposed consumption of wheat is not per se wheat as conventionally understood but in the forms of ‘wheat germ’ and ‘wheat bran’. The rationale of choosing these forms is recounted as under.

Wheat is the staple food of millions of people. It is also an important part of the daily diet of many millions more. There are many factors that influence the pattern of wheat consumption in the world which include price, supply, consumer income, availability of substitutes and politics. The quest for the nutritional potentials of wheat has been extensive and scientific studies have further contributed in suggesting optimal methods of harnessing the nutritive contents of wheat. This quest started with the consumption of whole grain products.
Whole grain products are an important source of dietary fibre. Four medium slices of wholemeal bread, for example, would provide 7.6g fibre which is 42 percent of the Recommended Daily Amount (RDA). Whole grain wheat contains useful amounts of several of the B vitamins including thiamine, riboflavin and niacin and also vitamin E. The vitamin and mineral content of wheat will depend on the proportion of germ, bran and endosperm present. It also contains the minerals potassium, iron, magnesium and zinc as well as trace elements such as selenium. The health benefits of wheat depend entirely on the form in which it is eaten. For instance wheat, in the form of bleached white flour formed after 60 percent processing has only very least amount of nutrients. Despite its health benefits, wheat is seldom consumed as ‘whole grain’, due to customary and traditional practice and the myriad culinary recipes which by and large identify wheat in the cuisine as a ‘bleached white flour’. Milling of wheat generates by-products like wheat germ and bran, which can be used to improve the technological performance and/or to integrate foods with healthy compounds.

Wheat germ is the most important nutritious part of wheat grain separated by ultra-modern milling technology which keeps free radical in check which in turn helps to prevent heart diseases, cancers and diabetes. It is also very important for vitality and healthy heart further lowering the risk of coronary heart diseases and helps to reduce obesity and delays ageing process. It contains about 27-28 g protein which is rich in all the essential amino-acids particularly lysine.

The presence of sugar in germ makes it acceptable and tasty. Over 80 percent of fat present in wheat germ is made up of Poly Unsaturated Fatty Acids (PUFA). Three table spoons of wheat germ will provide 20 percent Dietary Reference Intake of folic acid and vitamin E required for pregnant women.

Bran is the hard outer layer of grain and consists of combined aleurone and pericarp. Along with germ, it is an integral part of whole grains, and is often produced as a by-product of milling in the production of refined grains. When bran is removed from grains, they lose a portion of their nutritional value. Bran is particularly rich in dietary fibre, and omegas and contains significant quantity of starch, protein, vitamins and dietary minerals.

Wheat bran, one of the richest sources of dietary fibre can reduce the fasting and post lunch glucose level in diabetics. Wheat bran acts as phytoestrogens and is believed to protect against hormonally mediated breast, prostate and colon cancers. Wheat bran is used widely as a laxation aid. Wheat bran can help in weight control as it can replace high fat and high calorie food and leads to reduction in calories. Also addition of fibre in diet leads to a feeling of fullness and aids avoid ‘over eating’. As dietary fibre requires more energy to be digested, it can help in burning excess calories which is a boon to the diabetic and hyperlipidemic population, if all the hidden, health promoting properties of ‘wheat like alleviation of co-morbidities’ are explored for the fullest use of this nature’s gift.

It could be concluded that wheat germ and wheat bran are reported to have beneficial effect in alleviating specific health issues like diabetes and hyperlipidemia. In this ever changing scenario of emerging varieties of disease, existence of medical assistance without any side effect is much sought after remedy.“Wheat – A treasure to treasure”.

Potentials to unravel the immense nutraceutical benefits of wheat germ, bran and grass need to be studied in depth to address the health issues of the population, of both the affluent and the have-nots. This zealous venture claims realistic significance as they are capable of enhancing the health of diabetic, hyperlipidemic and the tuberculosis population: a commonly seen amalgamation in all developing countries.

The study attains significance under the pretext that the studies in India despite its massive production have not adequately exploited the viability of wheat in the forms of wheat germ and wheat bran. From the foregoing discussions, it could be concluded that wheat germ and wheat bran are effective contrivance in fight against degenerative diseases through acting as an adjunct intervention in ensuring better health for diabetic and hyperlipidemics; if not completely cure them of the disease. It would be a boon to the diabeticand hyperlipidemic population, if all the hidden, health promoting properties of ‘wheat like alleviation of co-morbidities’ are explored for the fullest use of this nature’s gift.

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Heat Treatment of Cereal Products

SPECIALIST in the heat treatment of dry ingredients, Revtech designs custom-made solutions for the heat treatment of cereal products: toasting, drying, stabilization, pasteurization of whole grains, flakes, germs, bran, flour…

The technology
With units from 200 kg/h to 5000 kg/h, the continuous Revtech technology is based on 3 simple principles:
• The product is transported by vibration in a spiral tube, which enables a very good mixing and an excellent homogeneity, all the particles receiving the same treatment.
• This stainless steel spiral pipe is heated by the electricity flowing in the wall of the pipe (high impedance tube). The product is then heated up by the contact of the hot tube. The excellent heat exchange (90% of the energy is transferred to the product) enables to get a very low energy consumption (around 80 kW to roast 500 kg/h).
• The atmosphere is controlled inside the tube. Steam can be injected to pasteurize, cold and dry air can be used to dry and cool down…

The applications
In one machine it is possible to carry out several applications for different products. The following applications are possible:
• Drying flour, grains or any part of cereals
• Pasteurizing flour, grains…
• Stabilizing germs and brans (drying + inactivation of the enzymes)
• Toasting flour, flakes or seeds such as corn, wheat grain, sesame, sunflower….
• Heat treating the flour to modify its properties (viscosity - cake flour)
Silo Based Grain Storage Technology for India

D D Koditkar, Dy. General Manager (Business Development)
M/s Fowler Westrup (India) Pvt. Ltd.

Foodgrain production in India is crossed 260 million tonnes in 2013-14 and it is increasing every year. Approximately 28-30% of the total grain production is procured by FCI. According to media, in June 2010, FCI were having grain of 60 million tonnes. Out of 60 million tonnes of grain, 17.68 million tonnes grain was lying outside in the open which is prone to go waste due to rain and other factors.

At the same time when some of the poorest belt in India is suffering due to monsoon failure, the thousands of tons of grain rot due to improper storage. In August 2011, Supreme Court has directed the Govt. of India for distributing the grain free to the hungry instead of rotting in Godowns and open.

Galvanized Silo Storage System is a proven scientific system for storage of foodgrains in Europe and America. This system ensures zero wastage due to moisture, fungus & rodents etc. In India this system is adopted to some extent by private sector since 1990 but it is limited to the process industry rather than for storage of grain for longer period.

Government of India is seriously planning to put up scientific storage solutions for food grains. This is an extremely important initiative in view of the huge wastage of precious food grains due to lack of proper storage facility. Govt. of India has executed Galvanized Silo Storage System for 550,000 tonnes in 2007-08 on BOO basis. Execution of such type of projects will reduce the stocks lying in the open and deteriorating due to moisture, rodents, fungus etc.

State Warehousing Corporations under Govt of India (FCI) should plan Galvanized Silo Storage System on their own. State Warehousing Corporation has the land and trained workers who are operating the traditional storage and distribution system (Godowns) at present.

The Galvanized Silo Storage System is affordable to small-scale entrepreneurs but not to farmers. Indian farmer is selling the excess production of grain in the local market or to FCI after harvesting. Farmer is not yet financially sound to hold the stock and take it to the market when prices of commodities are higher. Farming Co-operatives can afford to have such systems. Government should encourage such Co-operatives across the country.

We suggest minimum packaging of foodgrains. Only the Grain required to be distributed at taluka place should be packed at field depots of State Warehousing Corporations. FCI / State Government should distribute the Grain in Bulk to private entrepreneurs i.e. Rice Millers, Wheat Roller Flour Millers, Poultry / Cattle Feed manufacturers, Starch plants, Distilleries and Breweries, Solvent Extraction plants etc. This will avoid packaging expenses as well as wastages of Grain.
Galvanized Silos are used for storage of grains in bulk for longer period. These silos are made in Galvanized Steel and bolted in construction. The main parts of the silos are made in corrugated sheets instead of plain sheet. The strength of the sheet is increased due to corrugation. The entire silo components will be manufactured in modern manufacturing plants using CNC and special purpose machines under one roof. The installation of silos at site is much faster due to its bolted in construction.

The Galvanized Silos are equipped with accessories like Level Switches, Aeration System, Temperature Monitoring, Ventilation and Sweep Augers. These accessories help us to monitor the quality of stored grain inside the silos.

The Galvanized Silos with accessories are installed with grain conveying equipments like Bucket Elevators, Chain/Belt Conveyors and Post Harvest Equipments like Pre-cleaners, Fine Cleaners, De-stoner and dryers etc. The grain received in the Silo complex is handled by conveying equipments in bulk and stored in Galvanized Silos after cleaning. Moisture content in grain also plays an important role in storage life of grain. Grain with lower the moisture content and with proper aeration shall be stored in Galvanized Silos for longer period. If grain is having excess moisture content, it is reduced using grain drier online after the cleaning and before the storage of grain inside the Galvanized Silos. Grain is live and respirates while stored. This respiration creates hot spots inside the grain mass. Increase in hot spots helps moisture migration process which causes creation of fungus and lumps. The temperature monitoring system of Galvanized Silo detects the hotspots in grain mass. The aeration system is eliminating the hotspots in grain mass and maintains uniform temperature of stored grain. This maintains the quality of stored grain in Galvanized Silos.

Mechanization for handling of grain and storage in Galvanized Silos in bulk requires less manpower which reduces the cost of handling and storage. If required, we can do circulation of Grain from one silo to another silo easily with the help of mechanized handling system for verifying quality of stored grain.

Distribution / transportation of grain in bulk play an important role in order to minimizing the packages expenses.
We should plan the distribution system through bulk containers. It will avoid bagging expenses at base depot and cutting these bags at field depot. This could be planned with the help and expertise of authorities connected with Indian Railways.

We at Fowler Westrup (A joint Venture Company of John Fowler India and Westrup, Denmark) have taken advanced steps through technical collaboration with world’s leader Silos Cordoba from Spain for manufacturing entire range of Galvanized Silos in India based on Indian conditions since 2007. They have over 35 years of experience of manufacturing wide range of Galvanized Silos. They have executed many large projects of Galvanized Silos for grain storage for longer period. The capacity range of Galvanized Silo includes very low capacity of 5 MT to as high as 15000 MT and above. So far we have installed more than 300 Galvanized Silo Storage System on turnkey basis in India. The capacity range of installed Galvanized Silo Storage System is 100 MT to 30,000 MT with grain conveying and cleaning capacity upto 150 MT/hr.

We are also a manufacturer of wide range of grain handling equipments in Galvanized Steel with technical collaboration with renowned Danish company called Crocus. The capacity range of handling equipment is from 20 MT/ hr to 400 MT/hr.

We have developed post harvest equipments i.e. Pre-cleaners, fine cleaners, graders of high capacity upto 400 TPH required for Galvanized Silo Storage System. We are manufacturing these equipments since 1995 in India under license from Westrup, Denmark. Their expertise of decades could be transferred to Indian operation in a short time through exchange of technically qualified personnel, training at the Danish factory and at Danish sites, supervision by the Danish experts of Indian projects etc. After two decades of such relationship, the Indian promoters have reverse acquired 100 percent assets of the Danish company. We have also acquired 100 percent assets of a UK company which specializes in Opto Electronic Sorting of grains, pulses etc. The Management of the three operations in India, Denmark and UK has given us global opportunities and perception of what is needed to take up the handling of precious Agricultural products in India.

D D Kodikar,
Dy. General Manager (Business Development)
M/s Fowler Westrup (India) Pvt. Ltd.,
E-mail: kodikar@fowlerwestrup.com.

---
PURITY OF GRAINS & PULSES
Maintained with NICHROME Packaging

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- CSPP
- CSGP

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Packaging Solutions For  •  Liquid  •  Grains  •  Powders  •  Seeds  •  Snacks  •  Pharma  •  Personal Care
Cleaning of Wheat: Innovations in Wheat Cleaning
Wheat Conditioning and Milling Process

B S Muralidhara, National Manager; Head Sales – Industrial Milling, Buhler (India) Pvt Ltd

Wheat is a staple food around the globe, yet it is consumed in very diverse forms from country to country. China is the leading producer & consumer of wheat products and India comes second with wheat flour as the main ingredient for chapatti flatbreads. Many people consume grain-based foods such as bread, bakery products and pasta not merely for enjoyment, but they are basic staples in their everyday lives. This means that the grain milling industry and the downstream processing industry are expected to make healthy, pure, tasty and also affordable products. Grain is a valuable raw material. Its best possible utilization is therefore a precondition for the commercial success of the entire value chain up to the customer.

The challenge starts as early as in the grading and cleaning of the grain harvested. In the present scenario grain market demands consistent product quality and reliability, more efficient reduction of hazardous contaminants (such as ergots) & reduction of operational costs (less energy, less maintenance, less manpower, less space). New technologies such as color sorting & the Peeling process ensure a high quality and careful cleaning of the grain prior to grinding. Continuous further development of Buhler solutions giving consideration to the new end product quality requirements ensures top yields in the grinding process.

Mycotoxicology is currently a subject of international importance. With the increasing incidence of mycotoxins in the food chain – toxic to humans and animals – processors of a wide variety of foods, all over the world, are seeking more reliable sorting solutions. They need to remove these defects cost-effectively so that their commodities will meet the safety standards demanded of them.

Mycotoxin is a toxin produced by a fungus under special conditions of moisture and temperature. These fungi are aerobic (use oxygen) and microscopic. Mycotoxins can appear in food and animal feed as a result of fungal infection of the crop, for example Fusarium ear diseases in cereals or the infection of stored products. Mycotoxins are very resistant to temperature treatments and to conventional food processes such as cooking, freezing etc.

Colour sorter uses its Automatic calibration and product tracking to maintain constant quality, without the need for operator’s adjustment. A combination of most advanced camera and shape recognition identifier, the widest range of foreign materials, smallest spot defect, finer product damage, subtler colours are removed.
The DC-peeling (Decontamination by Peeling) is applied in the grain processing industry for reducing the contamination caused by bacteria, microtoxins and toxic heavy metals and for improving the quality of the finished product after the processing of various grain varieties. The DC-peeler removes the outermost layer of the grain (Pericarp). The peeling degree depends on the type of grain.

MHXT – The Buhler MHXT scourer is applied in grain milling operations both in the first and in the second cleaning sections for intensive scouring of numerous grain varieties.

The MHXT scourer efficiently removes adhering contaminants such as dust, sand, clods of earth etc., and thus optimally prepares the grain for grinding. The MHXT improves product sanitation by reducing the microbial count (bacteria, fungi etc.) and by reducing the insect and insect fragment counts. The scourer is generally equipped with a downstream aspiration channel. This enables neat separation of detached hull particles or surface dirt from the grain.

Latest Innovations In Wheat Grinding Technology

Innovations For A Better World - Hygienic Atta For Good Health & Happiness

PESA Mill is the heart of Buhler’s new innovative solution for the whole wheat atta process.

A stone-less grinding process and easy to clean equipment guarantees a hygienic and safe end product.

All major parameters like starch damage, water absorption, granulation, end product moisture, aroma and taste can be varied to your requirement consistently.

The best part of the process is fully controlled with latest Buhler Automation system like flour mill for a continuous consistent end product with less maintenance.

Single PESA mill replaces ~ 16 chakki’s in a plant of 130 tpd will reduce the space with savings in power consumption per tonne.

For further details contact:
Mallikarjuna S
Head – Marketing & Business Development
Buhler (India) Pvt Ltd
mailto:mallikarjuna.s@buhlergroup.com
www.buhlergroup.com

www.commodityindia.com
Annexure-1

Agricultural Produce (Grading & Marking) Act, 1937
(Agmark Standards)

Standards of various agricultural commodities prescribed under the provisions of the Agricultural Produce (Grading & Marking) Act, 1937 are popularly known as AGMARK Standards. AGMARK standards comply with minimum standards of quality & safety prescribed in Prevention of Food Adulteration Rules, 1955. In addition AGMARK standards differentiate between quality by having four grades for Wheat. The grades are differentiated on the basis of damaged grains, weevilled/shriveled/immature grains, other food grains, etc.

AGMARK Standards of Wheat
Grade designation and definition of quality of wheat

Special characteristics
(Maximum limits of tolerance)

<table>
<thead>
<tr>
<th>Grade Designation</th>
<th>Foreign matter (% by wt.)</th>
<th>Other food grains (% by wt.)</th>
<th>Other wheats (% by wt.)</th>
<th>Damaged grains (% by wt.)</th>
<th>Slightly damaged grains (% by wt.)</th>
<th>Immature shriveled and Broken Grains (% by wt.)</th>
<th>Weevilled Grains (% by wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1.0</td>
<td>1.6</td>
<td>5.0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>II</td>
<td>1.0</td>
<td>3.0</td>
<td>15.0</td>
<td>2.0</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>III</td>
<td>1.0</td>
<td>6.0</td>
<td>20.0</td>
<td>4.0</td>
<td>6.0</td>
<td>10.0</td>
<td>6.0</td>
</tr>
<tr>
<td>IV</td>
<td>1.0</td>
<td>8.0</td>
<td>20.0</td>
<td>5.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Note: In foreign matter, not more than 0.25% by wt. shall be mineral matter and not more than 0.10% by wt. shall be impurities of animal origin.

General characteristics
1. Wheat shall be the dried grains of Triticum vulgare and Triticum durum Desf,
2. Have uniform size, shape and colour;
3. Shall be sweet, hard, clean, wholesome and free from moulds, weevils, obnoxious smell, discoulouration, admixture of deleterious substances and all other impurities except to the extent as indicated in the Schedule;
4. be in sound merchantable condition;
5. not have moisture exceeding 12 percent.

Definitions
Foreign Matter: It includes dust, stones, lumps of earth, chaff, stem or straw and any other impurity including non edible seeds.

Other Food Grains: Edible food grains other than wheat.

Other Wheat: For this purpose wheat would be divided into two classes (1) Durum or Macaroni wheat and (2) vulgare or common wheat. Durum again would be sub divided into two colour groups (1) amber and (2) red and vulgare would be sub divided into three colour groups - (1) white (2) amber and (3) red.

Damaged Grains: Grains that are internally damaged or discoloured,damaged and discolouration materially affecting the quality.

Slightly Damaged Grains: Grains that are superficially damaged or discoloured, damaged and discolouration not materially affecting the quality.

Immature, Shriveled and Broken Grains: Immature and shriveled grains are those that are not properly developed, Broken grains are pieces of whole grains.

Weevilled Grains: Grains that are partially or wholly bored or eaten by weevils or other grain insects.

N.B.- Grades I and II should be free from living insect infestation.
Maximum tolerance limits for various food safety parameters such as poisonous metals, pesticide residues, aflatoxin, uric acid, etc. are as prescribed in Prevention of Food Adulteration Rules, 1955.

Standards Applicable For International Trade.

Codex Alimentarius Commission (CAC): Codex Alimentarius Commission (CAC) implements joint FAO/WHO Food Standards Programme. The purpose of the CAC programme is to protect the health of consumers and ensure fair practices in the food trade. The CAC is a collection of internationally adopted food standards presented in a uniform manner. Sanitary and Phyto-Sanitary Agreement and Technical Barriers to Trade Agreement of World Trade Organisation recognizes standards framed by CAC with respect to safety and quality aspects of food items. Thus for international trade standards framed by CAC are recognized.

Codex Standard For Wheat And Durum Wheat:
Description – Wheat is the grain obtained from varieties of the species Trititicum aestivum L.

Durum Wheat is the grains obtained from varieties of the species Tritticum durum Desf.

Quality & Safety Factors

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Wheat</th>
<th>Durum Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Max.</td>
<td>14.5% m/m</td>
<td>14.5% m/m</td>
</tr>
<tr>
<td>Organic extraneous matter, Maximum</td>
<td>1.5% m/m</td>
<td>1.5% m/m</td>
</tr>
<tr>
<td>Inorganic extraneous matter, Maximum</td>
<td>0.5% m/m</td>
<td>0.5% m/m</td>
</tr>
<tr>
<td>Test weight (wt. of a hundred litre volume expressed in Kg/hectoliter), Minimum</td>
<td>68</td>
<td>70</td>
</tr>
<tr>
<td>Shrunken &amp; broken kernels, Maximum</td>
<td>5.0% m/m</td>
<td>6.0% m/m</td>
</tr>
<tr>
<td>Edible grains other than wheat and durum wheat, Maximum</td>
<td>2.0% m/m</td>
<td>3.0% m/m</td>
</tr>
<tr>
<td>Damaged kernels, Maximum</td>
<td>6.0% m/m</td>
<td>4.0% m/m</td>
</tr>
<tr>
<td>Insect bored kernels, Maximum</td>
<td>1.5% m/m</td>
<td>2.5% m/m</td>
</tr>
<tr>
<td>Filth (impurities of animal origin, including dead insects), Maximum</td>
<td>0.1% m/m</td>
<td>0.1% m/m</td>
</tr>
<tr>
<td>Ergot (Sclerotium of the fungus Claviceps purpurea), Maximum</td>
<td>0.05% m/m</td>
<td>0.05% m/m</td>
</tr>
</tbody>
</table>

Toxic or Noxious Seeds

The wheat and Durum wheat shall be free from the following toxic or noxious seeds in amounts which may represent a hazard to human health.

Crotalaria (Crotalaria spp.), Corn cockle (Agrostemma githago L.) Castor bean (Ricinus communis L.), Jimson weed (Datura spp.) and other seeds that are commonly recognized as harmful to health.

Heavy Metals
Maximum levels for Lead 0.2 mg/kg.

Pesticide Residues:
Wheat and Durum wheat shall comply with following maximum pesticide residue limits.

<table>
<thead>
<tr>
<th>PESTICIDE</th>
<th>MRL or EMRL</th>
<th>(Mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4-D</td>
<td>MRL</td>
<td>0.5</td>
</tr>
<tr>
<td>ALDICARB</td>
<td>MRL</td>
<td>0.02</td>
</tr>
<tr>
<td>ANILAZINE</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>BENTAZONE</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>BIFENTHRIN</td>
<td>MRL</td>
<td>0.5</td>
</tr>
<tr>
<td>BIORESMETHRIN</td>
<td>MRL</td>
<td>1</td>
</tr>
<tr>
<td>BITERTANOL</td>
<td>MRL</td>
<td>0.1*</td>
</tr>
<tr>
<td>CARBARYL</td>
<td>MRL</td>
<td>5</td>
</tr>
<tr>
<td>CARBOFURAN</td>
<td>MRL</td>
<td>0.1*</td>
</tr>
<tr>
<td>CHLORDANE</td>
<td>EMRL</td>
<td>0.02</td>
</tr>
<tr>
<td>CHLORMEQUAT</td>
<td>MRL</td>
<td>5</td>
</tr>
<tr>
<td>CHLOROTHALONIL</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>CHLORPYRIFOS-METHYL</td>
<td>MRL</td>
<td>10</td>
</tr>
<tr>
<td>CYPERMETHRIN</td>
<td>MRL</td>
<td>0.2</td>
</tr>
<tr>
<td>DICHLORFLUANID</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>DIQUAT</td>
<td>MRL</td>
<td>2</td>
</tr>
<tr>
<td>DITHIOCARBAMATES</td>
<td>MRL</td>
<td>1</td>
</tr>
<tr>
<td>ETHEPHON</td>
<td>MRL</td>
<td>1</td>
</tr>
<tr>
<td>FENBUCONAZOLE</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>FLUCYTHRINATE</td>
<td>MRL</td>
<td>0.2</td>
</tr>
<tr>
<td>FLUSILAZOLE</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>GLYPHOSATE</td>
<td>MRL</td>
<td>5</td>
</tr>
<tr>
<td>HEXACONAZOLE</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>IMAZALIL</td>
<td>MRL</td>
<td>0.01</td>
</tr>
<tr>
<td>METHOMYL</td>
<td>MRL</td>
<td>0.5</td>
</tr>
</tbody>
</table>

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### Pesticide MRL or EMRL (Mg/kg)

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>MRL or EMRL</th>
<th>(Mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MONOCROTOPHOS</td>
<td>MRL</td>
<td>0.02</td>
</tr>
<tr>
<td>PHORATE</td>
<td>MRL</td>
<td>0.05</td>
</tr>
<tr>
<td>PIPERONYL BUTOX-IDE</td>
<td>MRL</td>
<td>10</td>
</tr>
<tr>
<td>PIRIMICARB</td>
<td>MRL</td>
<td>0.05</td>
</tr>
<tr>
<td>PROCHLORAZ</td>
<td>MRL</td>
<td>0.5</td>
</tr>
<tr>
<td>PROPICONAZOLE</td>
<td>MRL</td>
<td>0.05</td>
</tr>
<tr>
<td>PYRAZOPHOS</td>
<td>MRL</td>
<td>0.05</td>
</tr>
<tr>
<td>TEBUCONAZOLE</td>
<td>MRL</td>
<td>0.05</td>
</tr>
<tr>
<td>TERBUFOS</td>
<td>MRL</td>
<td>0.01</td>
</tr>
<tr>
<td>TRIADIMEFON</td>
<td>MRL</td>
<td>0.1</td>
</tr>
<tr>
<td>TRIADIMENOL</td>
<td>MRL</td>
<td>0.2</td>
</tr>
</tbody>
</table>

### Hygiene

Wheat and Durum wheat, after cleaning and sorting, and before further processing:

- Shall be free from microorganisms in amounts which may represent a hazard to health.
- Shall be free from parasites which may represent a hazard to health.
- Shall not contain any substance originating from microorganisms, including fungi, in amounts which may represent a hazard to health.
Annexure-2

FSSAI - Food Safety and Standards Rules, 2011

Atta

1. Atta or resultant atta means the coarse product obtained by milling or grinding clean wheat free from rodent hair and excreta. It shall conform to the following standards:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>Not more than 14.0 percent</td>
</tr>
<tr>
<td></td>
<td>(when determined by heating at 130-133ºC for 2 hours).</td>
</tr>
<tr>
<td>Total ash</td>
<td>Not more than 2.0 percent</td>
</tr>
<tr>
<td>Ash insoluble in dilute HCl</td>
<td>Not more than 0.15 percent</td>
</tr>
<tr>
<td></td>
<td>(on dry weight basis).</td>
</tr>
<tr>
<td>Gluten (on dry weight basis)</td>
<td>Not less than 6.0 percent</td>
</tr>
<tr>
<td>Alcoholic acidity (with 90 percent alcohol) expressed as H2SO4 (on dry weight basis)</td>
<td>Not more than 0.18 percent</td>
</tr>
</tbody>
</table>

It shall be free from rodent hair and excreta

2. Fortified atta means the product obtained by adding one or more of the following materials to atta, namely:

1. Calcium carbonate (prepared chalk, popularly known as Creta preparata).
2. Iron
3. Thiamine
4. Riboflavin, and
5. Niacin.

The calcium carbonate powder, if added for fortification shall be in such amount that 100 parts by weight of fortified atta shall contain not less than 0.30 and not more than 0.35 parts by weight of calcium carbonate. It shall be free from Rodent hair and excreta

3. Protein rich (paushtik) atta means the product obtained by mixing wheat atta with groundnut flour “or soya flour”, or a combination of both”, flour up to an extent of 10.0 percent. Soya flour which is a solvent extracted soya flour used in such mix shall conform to the standards of Soya flour laid down under 2.4.13 (1). It shall be free from insect or fungus infestation, odour and rancid taste. It shall not contain added flavour and colouring agents or any other extraneous matter. It shall conform to the following standards:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>Not more than 14.0 percent</td>
</tr>
<tr>
<td></td>
<td>(when determined by heating at 130-133ºC for 2 hours).</td>
</tr>
<tr>
<td>Total ash</td>
<td>Not more than 2.75 percent</td>
</tr>
<tr>
<td></td>
<td>(on dry basis).</td>
</tr>
<tr>
<td>Ash insoluble in dilute HCl</td>
<td>Not more than 0.1 percent</td>
</tr>
<tr>
<td></td>
<td>(on dry basis).</td>
</tr>
<tr>
<td>Total Protein (N x 6.25)</td>
<td>Not less than 12.5 percent</td>
</tr>
<tr>
<td></td>
<td>(on dry basis).</td>
</tr>
<tr>
<td>Crude Fibre</td>
<td>Not more than 2.5 percent</td>
</tr>
<tr>
<td></td>
<td>(on dry basis).</td>
</tr>
<tr>
<td>Alcoholic acidity (with 90 percent alcohol) expressed as H2SO4 (on dry weight basis)</td>
<td>Not more than 0.12 percent</td>
</tr>
</tbody>
</table>

It shall be free from rodent hair and excreta

Maida:

1. Maida means the fine product made by milling or grinding clean wheat free from rodent hair and excreta and bolting or dressing the resulting wheat meal. It shall conform to the following standards:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>Not more than 14.0 percent</td>
</tr>
<tr>
<td></td>
<td>(when determined by heating at 130-133ºC for 2 hours).</td>
</tr>
<tr>
<td>Total ash</td>
<td>Not more than 1.0 percent</td>
</tr>
<tr>
<td></td>
<td>(on dry weight basis).</td>
</tr>
</tbody>
</table>
Handbook on Processing Technology & Value Addition of Wheat and Wheat Products

<table>
<thead>
<tr>
<th>Ash insoluble in dilute HCl</th>
<th>Not more than 0.1 percent (on dry weight basis).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gluten (on dry weight basis).</td>
<td>Not less than 7.5 percent</td>
</tr>
<tr>
<td>Alcoholic acidity (with 90 percent alcohol)</td>
<td>Not more than 2.5 percent on dry basis</td>
</tr>
<tr>
<td>expressed as H₂SO₄ (on dry weight basis)</td>
<td>Not more than 0.12 percent</td>
</tr>
</tbody>
</table>

It shall be free from rodent hair and excreta.

If the product is to be used for bakery purpose, the following flour treatment agents in the quantities mentioned against each may be used, namely:

2. Fortified maida means the product obtained by adding one or more of the following materials to maida, namely:

(a) Calcium carbonate (prepared chalk popularly known as creta preparata).
(b) Iron,
(c) Thiamine,
(d) Riboflavin, and
(e) Niacin.

The calcium carbonate powder, if added for fortification, shall be in such amount that 100 parts by weight of fortified maida shall contain not less than 0.30 and not more than 0.35 parts by weight of calcium carbonate. It shall be free from Rodent hair and excreta.

3. Protein rich (paushtik) maida means the product obtained by mixing maida (wheat flour) with groundnut flour “or soya flour; or a combination of both” up to an extent of 10.0 percent soya flour which is a solvent extracted flour used in such mix shall conform to the standards of soya flour laid down under regulation 2.4.13 (1). It shall be free from insect or fungus infestation, odour and rancid taste. It shall not contain added flavour and colouring agents or any other extraneous matter. It shall conform to the following standards:

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Not more than 14.0 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total ash</td>
<td>Not more than 1.40 percent on dry basis.</td>
</tr>
<tr>
<td>Ash insoluble in dilute HCl</td>
<td>Not more than 0.1 percent on dry basis.</td>
</tr>
<tr>
<td>Total Protein (N x 6.25)</td>
<td>Not less than 12.5 percent on dry basis</td>
</tr>
<tr>
<td>Crude Fibre</td>
<td>Not more than 0.53 percent on dry basis</td>
</tr>
<tr>
<td>Alcoholic acidity (with 90 percent alcohol)</td>
<td>Not more than 0.12 percent</td>
</tr>
<tr>
<td>expressed as H₂SO₄ (on dry weight basis)</td>
<td>Not more than 0.12 percent</td>
</tr>
<tr>
<td>Gluten</td>
<td>Not less than 7.0 percent on dry basis</td>
</tr>
</tbody>
</table>

It shall be free from rodent hair and excreta.

2.4.3 Semolina (Suji or Rawa):

1. Semolina (suji or rawa) means the product prepared from clean wheat free from rodent hair and excreta by process of grinding and bolting. It shall be free from musty smell and off-odour and shall be creamy yellow in colour.

It shall conform to the following standards:

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Not more than 14.50 percent (when determined by heating at 130-133°C for 2 hours).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total ash</td>
<td>Not more than 1.0 percent</td>
</tr>
<tr>
<td>Ash insoluble in dilute HCl</td>
<td>Not more than 12.5 percent on dry basis.</td>
</tr>
<tr>
<td>Gluten (on dry weight basis)</td>
<td>Not less than 6.0 percent</td>
</tr>
<tr>
<td>Alcoholic acidity (with 90 percent alcohol)</td>
<td>Not more than 0.12 percent</td>
</tr>
<tr>
<td>expressed as H₂SO₄ (on dry weight basis)</td>
<td>Not more than 0.18 percent</td>
</tr>
</tbody>
</table>

It shall be free from rodent hair and excreta.
Food grains:

1. Food grains meant for human consumption shall be whole or broken kernels of cereals, millets and pulses. In addition to the under mentioned standards to which food grains shall conform, they shall be free from Argemone, Maxicana and Kesari in any form. They shall be free from added colouring matter. The food grains shall not contain any insecticide residues other than those specified in regulation 2.3.1 of Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011 and the amount of insecticide residue in the food grains shall not exceed the limits specified in Regulation 2.3.1. of the said Table Food Safety and standards (Contaminants, Toxins and Residues) Regulation, 2011. The food grains meant for grinding/processing shall be clean, free from all impurities including foreign matter (extraneous matter).

2. Wheat

Description: Wheat shall be the dried mature grains of Triticum aestivum Linn. or Triticum vulgare vill, triticum drum Desf., triticum sphaerococcum perc., Triticum dicoccum schubl., Triticum Compactum Host. It shall be sweet, clean and wholesome. It shall also conform to the following standards namely:—

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Moisture—</td>
<td>Not more than 14 per cent by weight (obtained by heating the pulverised grains at 130°C-133°C for two hours).</td>
</tr>
<tr>
<td>(ii) Foreign matter — (Extraneous matter)</td>
<td>Not more than 1 per cent. by weight of which not more than 0.25 per cent. By weight shall be mineral matter and not more than 0.10 per cent. by weight shall be impurities of animal origin.</td>
</tr>
<tr>
<td>(iii) Other edible grains</td>
<td>Not more than 6 per cent by weight.</td>
</tr>
<tr>
<td>(iv) Damaged grains</td>
<td>Not more than 6.0 per cent by weight including kernel bunt affected grains and ergot affected grains. The limit of kernel bunt affected grains and ergot affected grains shall not exceed 3.0 percent and 0.05 percent by weight, respectively.</td>
</tr>
<tr>
<td>(v) Weevilled grains—</td>
<td>Not more than 10 percent by count.</td>
</tr>
<tr>
<td>(vi) Uric acid—</td>
<td>Not more than 100 mg. per kg.</td>
</tr>
<tr>
<td>(vii) Aflatoxin</td>
<td>Not more than 30 micrograms per kilogram</td>
</tr>
<tr>
<td>(viii) Deoxynivalenol (DON)</td>
<td>Not more than 1000 micrograms per kilogram</td>
</tr>
</tbody>
</table>

Provided that the total of foreign matter, other edible grains and damaged grains shall not exceed 12 percent by weight.

Annexure-3

Ministry of Health and Family Welfare

(Food Safety and Standards Authority of India)


No. 1-83/Sci. Pan- Noti/FSSAI-2012.-The following draft of certain regulations to amend the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011, which the Food Safety and Standards Authority of India, with the previous approval of the Central Government, proposes to make, in exercise of the powers conferred by clause (e) of sub-section (2) of section 92 read with sub-section (2) of section 16 of the Food Safety and Standards Act, 2006, is hereby published as required by sub-section (1) of section 92 of the said Act, for the information of all persons likely to be affected thereby; and notice is hereby given that the said draft regulations shall be taken into consideration after the expiry of a period of sixty days from the date on which the copies of the Official Gazette in which this notification is published are made available to the public.
Objections or suggestions, if any, may be addressed to the Chief Executive Officer, Food Safety and Standards Authority of India, Food and Drug Administration Bhawan, Kotla Road, New Delhi -110 002;

The objections and suggestions, which may be received from any person with respect to the said draft regulations before the expiry of the period specified above, shall be considered by the aforesaid Authority.

Draft Regulations
1. (1) These regulations may be called the Food Safety and Standards (Food Products Standards and Food Additives) Amendment Regulations, 2013.
   (2) They shall come into force on the date of their final publication in the Official Gazette.

2. In the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011,--

   In regulation 2.4.1, for sub-regulation 2 relating to fortified atta, the following shall be substituted, namely:--

   Fortified atta means the product obtained by adding one or more of the following nutrients to atta, namely:--

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Level of fortification per Kg of atta (Not less than)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>900mg</td>
</tr>
<tr>
<td>Calcium carbonate, Calcium chloride, Calcium citrate, Calcium phosphate monobasic, Calcium phosphate dibasic,</td>
<td></td>
</tr>
<tr>
<td>Calcium phosphate tribasic.</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>60 mg</td>
</tr>
<tr>
<td>(a) Ferrous citrate, Ferrous lactate, Ferrous sulphate, Ferric pyrophosphate;</td>
<td></td>
</tr>
<tr>
<td>(a) Sodium Iron(III) Ethylene Diamine tetra acetate, Trihydrate (Sodium Ferredetate-Na Fe EDTA)</td>
<td>200mg</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>1400µg RE</td>
</tr>
</tbody>
</table>

   It shall be free from any extraneous matter including rodent hair and excreta."

   In regulation 2.4.2, for sub-regulation 2 relating to fortified maida, the following shall be substituted, namely:--

   The above table is applicable for fortified maida also.
Annexure-4

Abbreviations Used

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF</td>
<td>Acid Detergent Fibre</td>
</tr>
<tr>
<td>APMC</td>
<td>Agricultural Produce Market Committee</td>
</tr>
<tr>
<td>Atta</td>
<td>Refers to the pulverized whole wheat with brownish white color.</td>
</tr>
<tr>
<td>Chakki</td>
<td>Grinding wheat in between two stone plates</td>
</tr>
<tr>
<td>CP</td>
<td>Crude Protein</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardio Vascular Diseases</td>
</tr>
<tr>
<td>DM</td>
<td>Dry Matter</td>
</tr>
<tr>
<td>EDTA</td>
<td>Ethylene Diamine Tetra Acetate</td>
</tr>
<tr>
<td>FSSAI</td>
<td>Food Safety and Standards Authority of India</td>
</tr>
<tr>
<td>Godowns</td>
<td>Term for a storage shed or warehouse</td>
</tr>
<tr>
<td>Ha</td>
<td>Hectare</td>
</tr>
<tr>
<td>HAFED</td>
<td>Haryana State Cooperative Supply and Marketing Federation Ltd</td>
</tr>
<tr>
<td>HDL</td>
<td>High Density Lipoprotein</td>
</tr>
<tr>
<td>IDCS</td>
<td>Integrated Child Development Services</td>
</tr>
<tr>
<td>Kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>LDL</td>
<td>Low Density Lipoprotein</td>
</tr>
<tr>
<td>LMIC</td>
<td>Low and Middle Income Countries</td>
</tr>
<tr>
<td>MDM</td>
<td>Mid-Day Meal</td>
</tr>
<tr>
<td>MSP</td>
<td>Minimum Support Price</td>
</tr>
<tr>
<td>NBDMD</td>
<td>Nylon Bag Dry Matter Digestibility</td>
</tr>
<tr>
<td>NCDEX</td>
<td>National Commodity and Derivatives Exchange Ltd</td>
</tr>
<tr>
<td>NDF</td>
<td>Neutral Detergent Fibre</td>
</tr>
<tr>
<td>NFSM</td>
<td>National Food Security Mission</td>
</tr>
<tr>
<td>NSSO</td>
<td>National Sample Survey organisation</td>
</tr>
<tr>
<td>OMSS</td>
<td>Open Market Sales Scheme</td>
</tr>
<tr>
<td>PDS</td>
<td>Public Distribution System</td>
</tr>
<tr>
<td>RDA</td>
<td>Recommended Daily Amount</td>
</tr>
<tr>
<td>RFM</td>
<td>Roller Flour Mill</td>
</tr>
<tr>
<td>WTO</td>
<td>World Trade Organisation</td>
</tr>
</tbody>
</table>


SURESH D SAKHARE, AASHITOSH A INAMDAR, Agro Food Industry Hi Tech, Indian Atta (whole wheat flour) industry: history and recent trends, Vol.25(1), Jan/ Feb 2014, P.66-69/Dietary Fibres


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• Journal of Cereal Science, Volume 37, Issue 1, Pages 21-29

• M. Hruskova, J. Svec, O. Jirsa, Correlation between milling and baking parameters of wheat varieties

• Journal of Food Engineering, Volume 77, Issue 3, Pages 439-444


• M.R. Neuman, H.D. Sapirstein , E. Shwedyk, W. Bushuk, Wheat grain colour analysis by digital image processing I. Methodology

• Journal of Cereal Science, Volume 10, Issue 3, Pages 175-182

▼▼▼
Annexure-6

List of Wheat and Wheat Products Testing Laboratories, India

<table>
<thead>
<tr>
<th>Name of Laboratory</th>
<th>Contact Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES Laboratories (P) Ltd., Noida</td>
<td>Tel: 0120-3047900, 2562645, E-mail: <a href="mailto:Vishal.arora@aeslabs.com">Vishal.arora@aeslabs.com</a></td>
</tr>
<tr>
<td>Alpha Test House, Delhi</td>
<td>Tel: 011-45768766, 43703980, Mob: +91-8527763108, 8527763107, E-mail: <a href="mailto:info@alphatesthouse.com">info@alphatesthouse.com</a>; <a href="mailto:alphatesthouse101@gmail.com">alphatesthouse101@gmail.com</a></td>
</tr>
<tr>
<td>Arbro Pharmaceuticals Limited, New Delhi</td>
<td>Tel: 011-45754575, Mob: +91-9871700488, E-mail: <a href="mailto:arbrolab@arbropharma.com">arbrolab@arbropharma.com</a></td>
</tr>
<tr>
<td>Bhagavathi Ana Labs Ltd., Hyderabad</td>
<td>Tel: 040-23810505, E-mail: <a href="mailto:ballcentrallab@gmail.com">ballcentrallab@gmail.com</a></td>
</tr>
<tr>
<td>Choksi Laboratories Limited, Indore</td>
<td>Tel: 0731-2490592, 4243850, E-mail:<a href="mailto:v.choksi@choksilab.com">v.choksi@choksilab.com</a>, <a href="mailto:indore@choksilab.com">indore@choksilab.com</a></td>
</tr>
<tr>
<td>Delhi Test House, New Delhi</td>
<td>Tel: 011-27437327, 27435509, 27427672, E-mail: <a href="mailto:info@delhitesthouse.com">info@delhitesthouse.com</a>, <a href="mailto:dg@delhitesthouse.com">dg@delhitesthouse.com</a></td>
</tr>
<tr>
<td>Doctors’ Analytical Laboratories, Pune</td>
<td>Tel: 020-20291144, 32523374, 66541800, E-mail: <a href="mailto:doctors5lab@yahoo.com">doctors5lab@yahoo.com</a>, <a href="mailto:drabhay@satyam.net.in">drabhay@satyam.net.in</a></td>
</tr>
<tr>
<td>Geo Chem Laboratories Pvt. Ltd., Mumbai</td>
<td>Tel: 022-61915100, E-mail: <a href="mailto:laboratory@geochemgroup.com">laboratory@geochemgroup.com</a></td>
</tr>
<tr>
<td>Interfield Laboratories, Kochi</td>
<td>Tel: 0484-2217865, 2210915, 221838, E-mail: <a href="mailto:mail@interfieldlaboratories.com">mail@interfieldlaboratories.com</a></td>
</tr>
<tr>
<td>International Testing Centre, Panchkula</td>
<td>Tel: 0172-2565825, E-mail: <a href="mailto:itc86@yahoo.com">itc86@yahoo.com</a></td>
</tr>
<tr>
<td>Micro Chem Laboratory Pvt. Ltd., Navi Mumbai</td>
<td>Tel: 022-27787800, E-mail: <a href="mailto:deepa@microchem.co.in">deepa@microchem.co.in</a>, <a href="mailto:customercare@microchem.co.in">customercare@microchem.co.in</a></td>
</tr>
<tr>
<td>National Collateral Management Services Limited (N-MSL),</td>
<td>Tel: 040-27176840, E-mail: <a href="mailto:Ganesh.r@ncmsl.com">Ganesh.r@ncmsl.com</a>, <a href="mailto:vidya.k@ncmsl.com">vidya.k@ncmsl.com</a></td>
</tr>
<tr>
<td>Punjab Biotechnology Incubator (PBTI), Mohali</td>
<td>Tel: 0172 5020895, Mob: +91-9501096549, E-mail: <a href="mailto:pbti2005@yahoo.com">pbti2005@yahoo.com</a></td>
</tr>
<tr>
<td>Reliable Analytical Laboratories Pvt. Ltd., Thane</td>
<td>Tel: 02522-398100, E-mail: <a href="mailto:info@reliables.org">info@reliables.org</a>, <a href="mailto:reliable-labs@hotmail.com">reliable-labs@hotmail.com</a></td>
</tr>
<tr>
<td>Sargam Laboratory Pvt. Ltd., Chennai</td>
<td>Tel: 044-22491117, 22496736, 49674000, E-mail: <a href="mailto:enquiry@sargamlabs.com">enquiry@sargamlabs.com</a>, <a href="mailto:accounts@sargamlabs.com">accounts@sargamlabs.com</a></td>
</tr>
<tr>
<td>SGS India Pvt. Ltd., Chennai</td>
<td>Tel: 044-24962822, 24963844, 66693109, E-mail: <a href="mailto:Av.Abraham@sgs.com">Av.Abraham@sgs.com</a>, <a href="mailto:alagesan.K@sgs.com">alagesan.K@sgs.com</a></td>
</tr>
<tr>
<td>Shiva Analyticals (India) Limited, Bangalore</td>
<td>Tel: 080-27971322, E-mail: <a href="mailto:info@shivatech-india.com">info@shivatech-india.com</a></td>
</tr>
<tr>
<td>Shriram Institute for Industrial Research, Bangalore</td>
<td>Tel: 080-28410172, 28410165/166/167, E-mail: <a href="mailto:sribglr@vsnl.com">sribglr@vsnl.com</a>, <a href="mailto:sribglr@bgl.vsnl.net.in">sribglr@bgl.vsnl.net.in</a>, @shriraminstitute-bangalore.org</td>
</tr>
<tr>
<td>Shriram Institute for Industrial Research, Delhi</td>
<td>Tel: 011-27667267, 27667860, 27667436, E-mail: <a href="mailto:sridlhi@vsnl.com">sridlhi@vsnl.com</a></td>
</tr>
<tr>
<td>Sipra Labs Limited, Hyderabad</td>
<td>Tel: 040-23802004, E-mail: <a href="mailto:director@sipralabs.com">director@sipralabs.com</a>, <a href="mailto:sipra@sipralabs.com">sipra@sipralabs.com</a></td>
</tr>
<tr>
<td>T A Labs Private Limited, Chennai</td>
<td>Tel: 044-24474505, 64551505, E-mail: <a href="mailto:ubharatraj@trueanalytica.com">ubharatraj@trueanalytica.com</a>, <a href="mailto:talabs@trueanalytica.com">talabs@trueanalytica.com</a>, <a href="mailto:ubharatraj@gmail.com">ubharatraj@gmail.com</a></td>
</tr>
<tr>
<td>Vimta Labs Ltd., Hyderabad</td>
<td>Tel: 040-39848484, E-mail: <a href="mailto:Ashutosh.Mittal@vimta.com">Ashutosh.Mittal@vimta.com</a>, <a href="mailto:quality@vimta.com">quality@vimta.com</a></td>
</tr>
</tbody>
</table>
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- Rodent repellents and gate curtains prevent rodent & bird entry in warehouses
- Fire-fighting systems, Roof insulation, Docking arrangements prevent the warehouse from foreign particle entry and external hazards
- One-way traffic movement allows easy movement of trucks
- The entire Complex is affixed with Directions, Safety and Information Signage for disciplined and smooth movement of men, vehicle, and material

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Tel +91 22 3364 7500. Fax +91 22 3364 7502.

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