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A Monthly Magazine for Wheat, Milling, Baking & Allied Industries ....

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Assocom Institute of Bakery Technology & Management
Greater Noida (NCR Delhi)

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ASSOCOM EVENT CALENDER

Biscuit Processing Course (Biscuit Technologist: Module 1)	April 21-23, 2017	Greater Noida	http://aibtm.in
Bakery Premix Technology	April 21-23, 2017	Greater Noida	http://aibtm.in
Applied Baking Science (Biscuit Technologist: Module 2)	April 24-25, 2017	Greater Noida	http://assocom-india.com
Bread Technologist Module - 1 : Principles of Bread/Rolls	May 22-24, 2017	Greater Noida	http://assocom-india.com
Bread Technologist Module - 2 : Principles of Bread/Rolls	May 25-27, 2017	Greater Noida	http://assocom-india.com

INTERNATIONAL EVENT CALENDER

8th International Symposium Ready to Eat Foods	May 2017	Bhubneshwar	http://rte.assocom-india.com
International Bakery Seminar	July 2017	New Delhi	http://ibs.assocom-india.com
Global Milling Conference 2017	July 2017	New Delhi	http://gmc.assocom-india.com

The Ministry of Agriculture Raises Forecast of Record Food Grain Production

The Ministry of Agriculture (MOA) released its Third Advance Estimates of Production of Food Grains for the Indian Crop Year 2016/17 (July-June), raising grain production further to a record 273.4 million metric tons (MMT) compared to 271.9 MMT estimated in the Second Advance Estimate released on February 15, 2017. The forecast production is a whopping 21.8 MMT higher than last year's weak monsoon-affected harvest, and about 8.3 MMT higher than the previous record of 265.04 MMT in ICY 2013/14. The Ministry of Agriculture attributes the forecast record grain production to record planting, 'good' 2016 monsoon, and various policy initiatives taken by the government. The MOA's ICY 2016 grain production estimate includes MY 2016/17 rice, coarse grains, and pulse crops harvested last fall (kharif crop) and this spring (rabi crop), as well as the MY 2017/18 wheat and barley (rabi crop) harvested in March-May 2017. The record 2016/17 grain production estimate includes record production of:

•Rice at 109.2 MMT (vs. 106.7 MMT in 2013-14) on expected record yields (2.54 MT/hec vs previous record of 2.46 MT/hec in 2012/13)

•Wheat at 97.4 MMT (vs. 95.9 MMT in 2013-14) on near record planting and yields • corn at 26.1 MMT (vs. 24.3 MMT in 2013-14) on record planting (9.76 million hectares) and near record yields

•Pulses at 22.4 MMT (vs. previous record 19.3 MMT in 2013-14) on record planting (29.3 million hectares vs 26.4 million hectares in 2010/11).

Market sources report that the government's third advance estimate is over-optimistic as the overall weather condition during the current season has not been as favorable as observed during the previous record grain production season of ICY 2013/14. While the 2016 monsoon was normal for the country, some parts of north and south India received below normal rains, and the northeast monsoon which provides rainfall to the southern states (October to December) was relatively weak. Sources also report that the temperatures during the early part of the winter season (November/December) had been above normal, which affected soil moisture conditions for the winter planted rabi crops. Consequently, the weather conditions during the ICY 2016/17 have been less than ideal compared to the previous record food grain production year 2013/14.

The third advance estimates are based on three things: the provisional acreage estimates for both kharif and rabi crops; provisional yield estimates for the kharif crops based on the crop cutting survey reports from major states; and crop condition survey reports conducted before the harvest of the rabi crops. The MOA will further revise the ICY 2015/16 estimate in August (fourth advance estimate) based on the revised data from various state governments on acreage and yields (based on crop cutting experiments) for both kharif and rabi crops. The ICY 2016/17 estimates are likely to be finalized in February 2018.

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India's wheat imports slow down as traders grapple with unsold stocks

As good quality domestic crops hit the market, traders are saddled with unsold stockpiles in port silos. Unsold wheat at Indian ports highlights the plight faced by global grains trading companies amid a global supply glut. Photo: Mint.

Singapore: India's wheat imports have slowed in recent weeks as good quality domestic crops have hit the market, leaving traders saddled with unsold stockpiles in port silos.

Wheat inventories at ports have climbed to a record high of about 1.8 million tonnes, mainly cargoes shipped from Australia and the Black Sea region, trade and industry sources said.

"Flour mills are not keen to take imported wheat as they prefer local wheat which is good quality this year," said a trader who has been actively supplying the commodity to India. "It is a headache for traders who shipped cargoes anticipating strong demand."

Unsold wheat at Indian ports highlights the plight faced by global grains trading companies amid a global supply glut. Bumper crops have flooded many markets, dragging on prices for grains and hitting profits at agribusiness companies including Cargill, Bunge Ltd, Archer Daniels Midland and Louis Dreyfus Co.

Global corn, wheat and soybean inventories have risen for four straight years in the longest stretch of increases since the late 1990s, according to US government data. World grain and oilseed stocks are up 48% since 2012/13, compared with production growth of 18% and consumption growth of 17% over the same period.

India, however, the world's second-biggest wheat producer, has suffered a supply shortfall after two years of lower production. Importers shipped in close to 5 million tonnes of wheat in the 10-months to end-April, the most in a decade.

But in March, the country imposed a 10% import tax on the grain to curb imports at a time when Indian farmers were starting to harvest their crops.

"Imports have slowed down, or we can say imports have nearly come to a halt, because of the strong harvest and lower prices in most parts of the country," said R.K. Garg, managing director of R. R. Flour Mills and former president of the Roller Flour Millers Association of India. "Those who had import commitments have suffered losses due to a fall in prices here."

The state-run Food Corporation of India, the main grain procurement agency, has so far bought 27.1 million tonnes of new season wheat from farmers compared with last year's total of 23.0 million tonnes, food minister Ram Vilas Paswan said last week.

"The offtake of imported wheat is very slow," said the second trader. "We might see demand for imported wheat later this year or early next year."

For the year to June 2018, traders expect India's demand for imported wheat to slow, but it will still need to buy about 2-3 million tonnes as local supplies dwindle towards the end of the year. It will take a few years of bumper production to rebuild stocks to comfortable levels, they say.

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Strong Wheat Procurement

The government wheat procurement has been strong during the current season suggesting bumper harvest. Total government procurement of wheat through May 24, 2017, is estimated at 29.1 MMT compared to 22.8 MMT last year during the corresponding period.

The Food Corporation of India, GOI Wheat procurement in the major surplus states has been significantly higher than in the last two years. Procurement in Punjab and Haryana will be over by late May as farmers bring their produce immediately after harvest (first week of May); high local taxes preclude any significant private purchases. Procurement is likely to continue in other states through June on harvest of late season wheat; also, farmers tend to stagger post-harvest sales as private trade competes with the government procurement. While procurement will officially continue through June, volumes are likely to taper off in most states in the next two weeks. Market sources expect MY 2017/18 wheat procurement to be around 31 MMT compared with the central government's procurement target of 33 MMT. Domestic prices have been hovering around the government's MSP in most producing states due to the ongoing government procurement operation. The local wheat prices in major wheat surplus states currently range from INR 16,040 ($248) to INR 16,810 ($260) per metric ton, around the government's MSP of INR 16,250 ($252 per metric ton).

Market prices are likely to remain steady in June on the ongoing government procurement program. Future price movement will largely depend on the government import duty policy and international price movements.

FSSAI Implements Food Fortification Regulation

FSSAI published a draft regulation related to food fortification. As of April 17, 2017, FSSAI fully implemented its new Food Safety and Standards (Fortification of Foods) Regulations, 2017.

Background: On January 3, 2017, FSSAI published a draft food fortification regulation in the Official Gazette of India pertaining as an addendum to the Food Safety and Standards (Food Product Standards and Food Additives) Regulations, 2011. The draft regulation specified fortified food products including salt, vanaspati, wheat flour (atta), vegetable oil, milk, refined wheat flour (maida), and fortified rice. A logo for packaging and labeling requirement was also included in the draft Regulation

File No. 11/03/Reg/Fortification/2014 (pt. I)
Food Safety and Standards Authority of India
(A statutory Authority under the Ministry of Health and Family Welfare, Govt. of India)
FDA Bhawan, Kotla Road, New Delhi-110002

The 19th May, 2017

Subject: Direction under Section 16(5) of Food Safety and Standards Act, 2006 regarding Operationalisation of Food Safety and Standards (Fortification of Foods) Regulations, 2017 relating to standards for fortification of food.

In exercise of the powers conferred under Section 92 of the Food Safety and Standards Act, 2006 (34 of 2006), the FSSAI has framed the Food Safety and Standards (Fortification of Foods) Regulations, 2016.

2. These regulations were operationalised in exercise of the power vested with the Food Authority under Section 18 (2) (d) read with Section 16(5) of the Food Safety and Standards Act, 2006 with effect from 16.10.2016 and subsequently the same were notified in the gazette of India dated 23.12.2016 inviting comments and suggestions from the stakeholders.

3. The above regulations have been revised so as to include standardized milk in the list of milk variants that are permitted for fortification with vitamin A and D. Accordingly the Food Safety and Standards (Fortification of Foods) Regulations, 2017, enclosed herewith, have been made operational w.e.f. 17.04.2017.

4. This issues with the approval of the Competent Authority in exercise of the power vested under Sections 18(2) (d) and 16(5) of Food safety and Standards Act, 2006.

(Sunil Bakshi)
Advisor (Regulations)

Enclosure: as above

To

1. All Food Safety Commissioners,
2. All Authorized Officers, FSSAI,
3. All Designated Officers, FSSAI.

Copy for information to:

1. PPS to Chairperson, FSSAI
2. PS to CEO, FSSAI
3. All Directors, FSSAI

★★★★★

‘Father of wheat revolution’ D.S. Athwal passes away in US

Often called the ‘Father of Wheat Revolution’, agriculture scientist Dilbagh Singh Athwal has passed away in the US, a Punjab Agricultural University (PAU) official said on Monday. He was 89.

Vice Chancellor B.S. Dhillon, officers and scientists of the university paid tributes to Athwal, who died on Sunday, at a condolence meeting held at the PAU campus here.

Dhillon said the outstanding contributions made by Athwal in the field of agriculture “remain unsurpassable till date”.

“Dr Athwal was one of the stalwarts who played a pivotal role in initiating Green Revolution in the country. He was a well-known geneticist, plant breeder and agricultural scientist of international repute,” Dhillon said. “Athwal developed world’s first grain pearl millet hybrid ‘Hybrid Bajra 1’ in 1965 that heralded a new era in cultivation of this important crop,” he said.

Athwal was instrumental in developing ‘PV 18’ in 1966 and the most popular amber grained wheat variety ‘Kalyansona’ in 1967, named after the village ‘Kalyanpur’ in Punjab where Athwal was born in 1928.

Punjab, known as the ‘Green Revolution’ state, had heralded India’s campaign to ensure food grain security for the country in the 1960s.

Athwal served as founder head of Department of Plant Breeding in PAU, and made contributions to the genetics and breeding of pearl millet, wheat, gram and tobacco.

A large number of genetic stocks developed by him made a significant contribution to future research on bajra breeding and genetics.

In 1967, he joined the management of International Rice Research Institute (IRRI) in the Philippines and eventually served as the Institute’s first Deputy Director General. At IRRI, he introduced many innovations in rice breeding. The University of Sydney bestowed the degree of Doctor of Philosophy on him in 1955.

In 1964, he was conferred with Shanti Swarup Bhatnagar Prize of the Council of Scientific and Industrial Research (CSIR), which is the highest Indian award in the science category.

He was also decorated with Padma Bhushan in 1975 by the government for his contributions to biological science. After his retirement, he settled in New Jersey, US, where he breathed his last.

The university has named its new guest house after his name as ‘Dr. D.S. Athwal International Guest House’.

As a mark of respect to Athwal, the PAU remained closed for half a day.

★★★★★

Grain output up five times despite climate change: ICAR

India is exporting rice worth 40,000 crore annually and other food products despite facing massive adverse impact of climate change, said Trilochan Mohapatra, Secretary in the Department of Agriculture Research and Education.

Mr. Mohapatra, also the Director General of the Indian Council of Agricultural Research, said the massive upswing in food production was possible due to application of science in the agricultural field. He was delivering the keynote address at the 4th Convocation of SOA University recently.

"The country is facing a situation where the water table has declined as also rainfall by more than 100 mm compared to the1950s; the minimum temperature has risen by 1.6 degrees Celsius and 102 out of the 140 million hectares of cultivable land lies degraded, but food production has increased manifold to feed a population of 1.25 billion people," Mr. Mohapatra said.

"It is frightening to note that land is more than 80% deficient in nitrogen, more than 70% deficient in phosphorous and more than 20 to 25% deficient in many mirco-nutrients. We lose 16 tonnes of soil per hectare per year through land erosion," said the agricultural scientist.

Despite these limitations, India's grain production had increased five times, milk production by 8.5 times, egg production by 43 times and fish production by 13 times since the 1950s. The country's horticultural produce had gone up three times since the 1990s, Mr. Mohapatra said.

"This was made possible because we applied science to agriculture which ushered in the green revolution making us self-sufficient and self-reliant. It is a huge growth in the face of all these adversities. We applied the science of genetics to grow the largest basmati rice which is being exported and it had made us self-sufficient in wheat now," he said. Mr. Mohapatra said a pomegranate farmer in Gujarat was earning a net profit of Rs. 10-15 lakh per year through cultivation of the fruit which had been made possible because of scientific application in agriculture and it indicated as to how India's food basket was diversified.

He emphasising on integration of research, education and dissemination and application of new knowledge -- the main source of agricultural growth in future.

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WEEKLY INTERNATIONAL WHEAT PRICES

Conversion #	US Hard Winter #2 Ordinary Gulf IGC US$/Ton	#2 Ordinary Gulf IGC US$/Ton	Canadian #1 CWRS, 13.5 St. Lawrence IGC US$/Ton	Argentinian Trigo Pan Up River F.O.B. IGC US$/Ton	Australian Standard White IGC US$/Ton	US Soft Winter Red USDA US$/Bush 0.027216	#2 Gulf US$/Ton
May, 2016 AVG		193.20	226.60	202.00		5.1425	188.95
Jun., 2016 AVG		198.00	225.75	210.00		5.0506	185.58
Jul., 2016 AVG		187.75	209.50	210.00		4.5738	168.05
Aug., 2016 AVG		188.20	203.20	215.00		4.2855	157.46
Sept., 2016 AVG		188.25	202.75	201.25		4.2888	157.58
Oct., 2016 AVG		192.75	215.50	184.00		4.4550	163.69
Nov., 2016 AVG		190.60	209.60	176.40		4.5355	166.65
Dec., 2016 AVG		186.75	219.25	168.00		4.4163	162.27
Jan., 2017 AVG		200.60	225.80	177.20		4.7065	172.93
07-Feb-2017		206.00	222.00	185.00		4.8575	178.48
14-Feb-2017		217.00	228.00	184.00		5.0400	185.19
21-Feb-2017		211.00	223.00	188.00		4.9250	180.96
28-Feb-2017		206.00	222.00	188.00		4.8125	176.83
Feb., 2017 AVG		210.00	223.75	186.25		4.9088	180.36
07-Mar-2017		207.00	214.00	192.00		4.9400	181.51
14-Mar-2017		201.00	211.00	192.00		4.7750	175.45
21-Mar-2017		194.00	220.00	192.00		4.7350	173.98
28-Mar-2017		191.00	218.00	190.00		4.7350	173.98
Mar., 2017 AVG		198.25	215.75	191.50		4.7963	176.23
04-Apr-2017		192.00	215.00	190.00		4.7650	175.08
11-Apr-2017		193.00	216.00	189.00		4.8375	177.74
18-Apr-2017		189.00	220.00	189.00		4.7150	173.24
25-Apr-2017		189.00	216.00	189.00		4.5375	166.72
Apr., 2017 AVG		190.75	216.75	189.25		4.7138	173.20
02-May-2017		206.00	217.00	189.00		4.9050	180.22
09-May-2017		198.00	219.00	188.00		4.7050	172.88
16-May-2017		196.00	223.00	190.00		4.6675	171.50
23-May-2017		200.00	228.00	188.00		4.7300	173.79
30-May-2017		201.00	232.00	188.00		4.7400	174.16
May, 2017 AVG		200.20	223.80	188.60		4.7495	174.51

Please note that prices are subject to revisions

Source : ESCG, FAO

Global Miller's Symposium: exchange between the best

In his opening speech Volkmar Wywiol, co-owner of Mühlenchemie, already explained what the 350 scientists and practitioners from 54 countries could expect of the Global Millers Symposium: nothing less than a discussion of the challenges the processors of wheat, one of the world's most important staple foods, currently have to overcome. The event had been organized by the International Association for Cereal Science and Technology (ICC) and Mühlenchemie, the specialist in flour improvement and flour fortification from Hamburg, Germany. "Only an exchange of information and the transfer of know-how can solve the problems we shall have to face in future in order to feed the world's population", said Wywiol, setting the motto for the two informative days.

35 lectures held by research scientists, economists, practitioners and representatives of public institutions offered the participants valuable new information and ideas. The speakers included such eminent experts as Vito Martielli (Analyst for Grains & Oilseeds, Rabobank, RaboResearch Food & Agribusiness); Bernard Valluis (President of the European Flour Millers' Association); Hans-Joachim Braun (Director of the Global Wheat Program & CRP WHEAT); Drew Lerner (President of World Weather Inc.); Fred Brouns (Maastricht University & Brouns Health Food Consulting), and Scott Montgomery (Director of the Food Fortification Initiative).

Changing raw materials

The subject of the first main group of topics at the symposium was the enormous volatility of the raw material market, that mills have to contend with. The main drivers of this development are worldwide population growth, increasing prosperity in emerging markets, the trend towards urbanization, and climate change. It became clear that the wheat-growing and wheat-importing areas are constantly shifting. Large amounts of wheat are currently being imported by the sub- Sahara regions and South-East Asia, whereas the states around the Black Sea are exporting more wheat. Topics raised in this connection were the possibilities offered by increasing productivity, opening up new growing areas and approaches to regulating the raw material markets.

Health awareness as a nutrition trend The subject of the following sessions was: which nutrition trends and consumer wishes are becoming more important at present and for the future? Here we see a contrast between the needs of traditional, regional bread and pasta as well as products that are now consumed around the globe. A mill has to serve both sectors. Then there are lifestyle trends triggered by increasing prosperity and urbanization in the Western world and the emerging markets. Products with a health promise will become more and more important in the future. It also became clear that some nutrition trends are little more than media and marketing hypes and have no scientific foundation. Mills therefore have to contend with prejudice against wheat and gluten although comparatively few people are really affected by an allergy or intolerance to these substances.

Significance of fortified foods But not only can and must the milling industry satisfy the hunger of the world's increasing population. For most people bread, biscuits and crackers, pasta and pizza are basic foodstuffs. By fortifying their flours, mills take on an important responsibility for preventing malnutrition and disease, especially in the developing countries but in industrialized nations, too. Why foods fortified with vitamins and minerals are an efficient means of providing additional nutrients, and what progress has been made in this field in recent years, was the subject of a further group of topics.

Solutions for millers : The agenda of the second day was devoted to technical lectures offering the millers practical solutions for their daily work and presenting innovations for fortifying their flour and enhancing the quality of their products. A thread running through them all was how to reconcile changing overall conditions with increasing responsibility while ensuring that the company remains competitive.

Dialogue strengthens an entire industry "Our aim when planning the symposium was to relate questions concerning everyday work to the overall developments of the market. The participants from 54 countries made us aware that the challenges to the industry can only be solved in the context of an international network. With this symposium we were able to give an important boost to such cooperation", said Michaela Pichler, Secretary General of the ICC, after the two days packed with a concentrated transfer of knowledge.

Lennart Kutschinski, Managing Director of Mühlenchemie and co-initiator of the symposium, also expressed his satisfaction with the meeting: "Besides the technical programme it was important to us to offer the millers a forum, in the meetings and discussions between the lectures and also at the evening events, where they could exchange knowledge and experience and learn from one another. Although they are all businessmen and in competition with each other, the millers of the world are one family. We experienced that yet again in Hamburg."

★★★★★

Co-Milling of Wheat & Barley – A Practical Solution for the Production of Healthy & Functional Flour

Introduction : Food barley contains a number of important constituents that have beneficial health effects. Most notable is β-glucan content which has been found to improve blood glucose levels and satiety and decrease the risk of cardiovascular disease as well as certain types of cancers. Therefore there is interest in adding food barley to food products to improve the nutritive benefits.

Hulless barley (HB) could be milled into flour in a wheat flour mill setting. However, this required significant modifications of the wheat milling diagram in order to mill hulless barley without using any dehulling or pearling equipment (Sarkar & Malcolmson, 2008). Using this approach resulted in a number of compromises including reductions in throughput and flour yield and also a wider range of particle size distribution which were directly related to the sticky, soft and woolly nature of the ground barley material that reduced the sifting efficiency of the milled products.

Using a new approach of co-milling of wheat and barley helped improve the sifting efficiency of the blend reducing and almost eliminating the compromises observed when barley was milled on its own. The improvements were dependent on the barley type and proportion of it in the blend.

Methods and Materials : The research project carried out at the Canadian International Grains Institute on co-milling of Canada Western Red Spring (CWRS) wheat and barley involved three different types of barley as described below:

- McGwire (regular starch)
- CDC Rattan (partial waxy)
- CDC Fibar (fully waxy)

Figure 1. CWRS and the 3 barley types in the blends (L to R: CWRS, McGwire, CDC Rattan & CDC Fibar)

Each barley type was milled with CWRS (No. 2 CWRS 13.5) in varying proportion as described in Table 1, to assess the impact on milling performance.

Table 1. Wheat and barley blend percentages

Blend, %					
CWRS	McGwire	CWRS	CDC Rattan	CWRS	CDC Fibar
80	20	80	20	80	20
70	30	70	30	70	30
60	40	60	40	60	40

In order to more fully compare the effect on the milling performance of all the wheat and barley blends more objectively, an additional milling of a pure barley blend of McGwire and CDC Rattan was milled to provide results to be expected from lower end of the milling performance spectrum. Additionally, a milling of the CWRS that was used for blending was also milled at 100% level to reflect the upper end of the milling performance spectrum.

These CWRS and barley blends were prepared by cleaning the barley separately using the cleaning house of the Canadian International Grains Institute's (Cigi) pilot wheat flour mill and storing the barley in one of the tempering bins without tempering it. Bhatty (1997) established barley be best milled dry. The CWRS was also cleaned separately and tempered to the optimum milling moisture of approximately 16.0-16.5% and stored in a separate tempering bin.

Figure 2. CWRS and barley being blended under the bins

The blending was then carried out under the tempering bins to the desired proportions as required for a given test run (Figure2).

The millings of all wheat and barley blends were carried out in the pilot wheat flour mill using the same flow diagram as used when milling wheat flour. Bhatty (1997) also suggested roller milling as a better method for milling of barley into flour. There were some small changes made with respect to flour sieves at the very end of the reduction passages in order to ensure that the flour yields remain within acceptable range by using sieves with slightly more open apertures while maintaining a balance in terms of particle size distribution and flour yields.

The selection of the coarse (more open) flour sieves at the tail end of the reduction system has an added advantage. The β-glucan content is more concentrated in the flour streams coming from this end of the system.

Results and Discussions : Milling food barley by itself is difficult as it is sticky. The degree of difficulty increases as barley starch properties tends to become waxy, or lower in amylose content. Barley with regular starch is easier to mill compared to waxy barley types. Waxy barley varieties contain higher levels of β-glucan than the regular starch barley varieties. All types of barley milling requires modification of flow diagram. In order to allow sticky barley flour to pass through the flour sieves the aperture size selected is coarser. For the milling of waxy barley the aperture size is even coarser as it is stickier (Sarkar & Malcolmson, 2008). The barley flour produced this way will have a wider range of particle size distribution. Despite using sieves with a coarser aperture in the flow diagram the success in the milling process will be limited due to limitations in throughput (flow rate), reduced flour yields and wider ranges of particle size distribution.

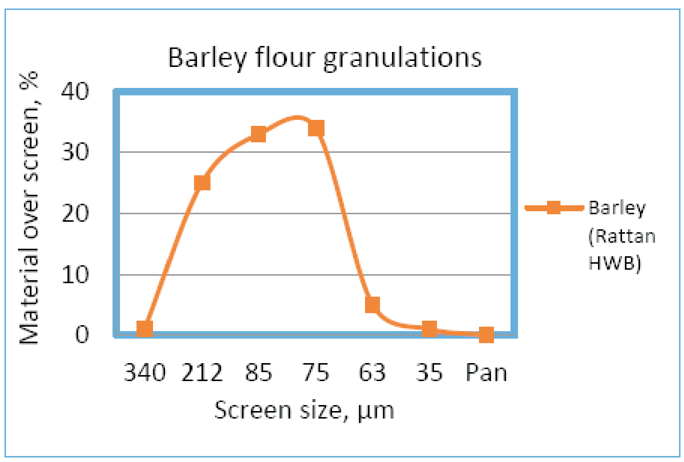

Fig 3. Particle size distribution for flour from 100% barley

Fig 4. Specks present in barley flour magnified

Figure 3 shows the particle size distribution from a milling of 100% CDC Rattan. Although over 75% of the flour is very fine, the coarse flour sieves used allow about 25% of the flour of coarser particle size than what is commonly considered as flour particle size (149 microns or less). As a result the flour is specky (Figure 4). This is one compromise that is required when milling 100% hulless food barley into flour. Additionally, the load to the mill needs to be reduced around 30% or more depending on the level of stickiness. Expected flour yields of hulless waxy barley are generally around 60% (Sarkar & Malcolmson, 2008).Co-milling of barley with wheat helps alleviate these difficulties. The load to the mill was maintained at all times for all blends of wheat and barley. By contrast when milling barley only the load had to be reduced significantly from 0.47 tonnes an hour to 0.25 tonnes per hour.

The flour yields are provided in the Table 2 and graphically illustrated in the Figures 5a and b. As can be seen the flour yields are influenced by the barley types that are being milled at all three blend levels. McGwire showed higher flour yields relative to CDC Fibar followed by CDC Rattan (Figure 5a). It has been shown in earlier work that regular starch type barley had improved milling performance than partial and fully waxy starch type hulless barley with respect to processing and flour yield levels. The same has also been shown in work done under laboratory environment (Bhatty, 1999).

Figure 5b shows flour yields are also influenced by the percentage of barley being blended with wheat. When the percentage of barley in the blend is higher the flour yield is reduced. The range of flour yields for all co-milling was 64.0% to 71.3%. Although the flour yield of 64.0% obtained on a blend of 60% CWRS wheat to 40% Rattan barley appears to be low it is important to remember that the load (throughput) on the mill was not reduced and the majority of flour particle size (90%) was below 163.6 micron, showing the benefit of co-milling the waxy CDC Rattan barley with wheat.

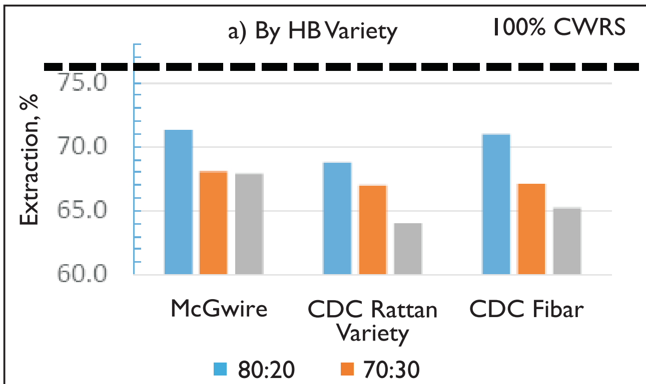

Figure 5a. Flour yield comparison - barley types

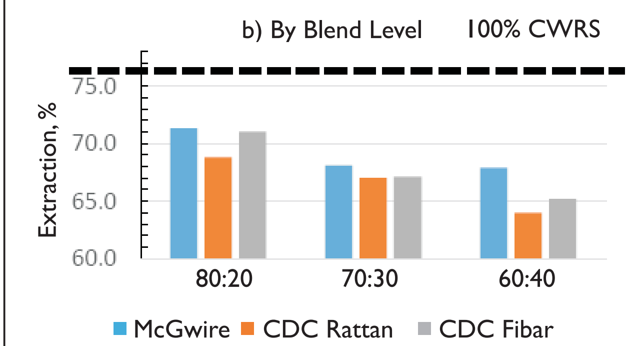

Figure 5b. Flour yield comparison - blend levels

Table 2. Wheat, barley and blend processing and analytical data

	CWRS	CWRS / McGwire			CWRS / CDC Rattan			CWRS / CDC Fibar			McGwire /CDC Rattan
	100	80/20	70/30	60/40	80/20	70/30	60/40	80/20	70/30	60/40	50/50
Wheat/Barley (13.5% mb)											
Mill Load (Feed/ Hr.) , kg/hr.	470	470	470	470	470	470	470	470	470	470	250
Protein, %	14.0	16.3	16.1	16.0	16.2	16.0	16.0	16.6	16.4	16.4	16.6
Ash , %	1.61	1.90	1.87	1.89	1.87	1.88	1.90	1.87	1.88	1.90	1.88
Flour yield , %	76.1	71.3	68.1	67.9	68.8	67.0	64.0	71.0	67.1	65.2	79.3
β-glucan in Wheat & barley blend, %	---	1.50	2.78	2.35	2.41	3.21	3.58	2.30	3.21	3.97	6.05
β-glucan in Flour, %	---	0.44	0.65	0.82	0.86	1.09	1.34	0.91	0.90	1.21	4.93
Loss in β-glucan, %	---	1.06	2.13	1.53	1.55	2.12	2.24	1.39	2.31	2.76	1.12

The particle size distribution (PSD) of all the wheat and barley flour blends is shown in Table 3. Particle size for all the wheat and barley blends ranged from 90% below 143.6 µm to 163.6 µm. This range when compared to CWRS wheat flour of 136.5 µm is within the acceptable for flour particle size and the appearance and the feel of the flour from each co-milling reflected this. Acceptable PSD for the co-millings were achieved as blending barley with wheat helps to improve the sifting properties of the barley (Figure 6). By contrast, the particle size of the resulting flour from the milling of McGwire and Rattan (50:50 level) was much coarser with 90% of the material below 356.4 µm (Figure 6). This flour also had a wider range of particle size with a lot of specks resulting in an unrefined appearance (Figure 7). This is due to the fact that flour sieves used for pure barley blend is much coarser to allow passage of flour and fine material through relatively more open apertures as sifting properties of barley blend is poor.

The percentage of flour streams produced in various passages of the milling process when milling wheat, is indicative of its milling performance. Higher percentage of flour production in 1M (1st reduction), 2M (2nd reduction), 3M & 4M is indicative of good milling performance as it contributes to low ash flour production overall. During co-milling of barley and wheat the percentage of flour produced is somewhat different when compared to milling wheat flour. The percentage of flour streams produced from the lower end of the reduction and break system is higher during co-milling than when compared to wheat only (Figure 8). This occurs as barley content in the blend promotes higher concentration of material more towards the end of the system due to lower efficiencies in sifting. However, this behaviour has a positive outcome with respect to distribution of the β-glucan, the key nutrient of interest.

Table 3. Wheat, barley and blend flour particle size & rheological data

	CWRS	CWRS / McGwire			CWRS / Rattan			CWRS / Fibar			McGwire /Rattan
	100	80/20	70/30	60/40	80/20	70/30	60/40	80/20	70/30	60/40	50/50
MASTERSIZER											
d(0.9) um	136.5	143.6	160.5	159.0	150.7	154.3	163.6	155.9	152.3	162.6	356.4
FARINOGRAM											
Absorption, %	67.6	66.9	66.1	65.6	66.6	67.4	67.7	67.6	67.7	68.7	NT
Dough development time (DDT), min	7.2	7.1	5.3	4.2	5.2	4.6	4.5	5.0	4.7	4.6	NT
Stability, min	14.0	13.4	10.1	8.3	8.0	6.9	5.9	7.0	7.4	6.4	NT
Mixing tolerance index (MTI), BU	21	29	37	45	44	53	59	49	50	55	NT

The most beneficial outcome of co-milling wheat and barley was that minimal changes were required in the mill flow diagram with respect to using somewhat coarser sieves at the very end of the reduction passages this helped in producing flour from wheat and barley blends with similar granulations as wheat flour. Comparable granulations helped in producing flour with better color and fewer specks.

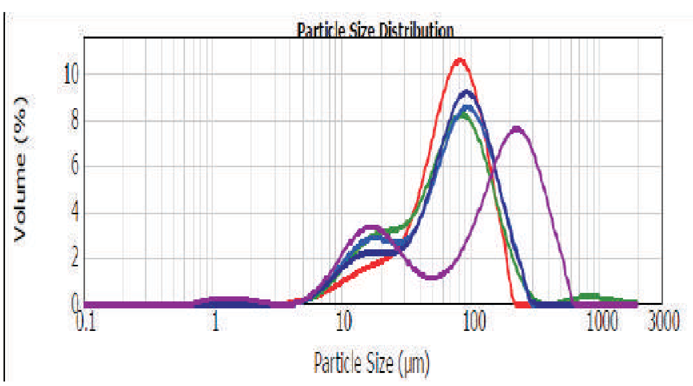

Fig 6. PSD comparison of 60/40 wheat/ barley & barley blend

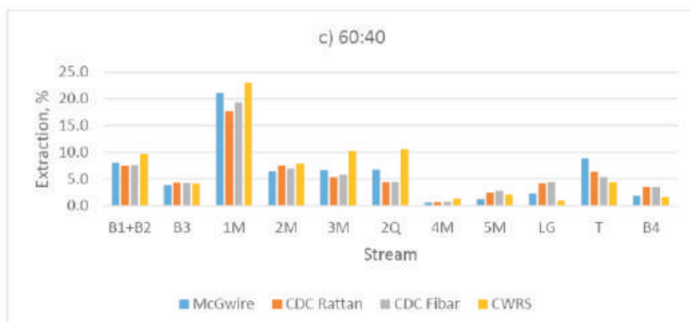

Figure 8. Comparative yields of flour streams from wheat and wheat and barley blends

Figure 9 shows the β-glucan percentage in various flour streams from the milling of 60/40 blend of wheat and barley. From this it is noted that the Low Grade (LG) stream, which is the last reduction passage, has the highest level of β-glucan among all flour streams. The T (tailings) and 4BK (Fourth break) also showed high levels of β-glucan. These were the streams that also showed higher level of percentage production compared to streams from milling of wheat flour (Figure 8). This behaviour allows millers to aggregate higher yields of flour with higher concentration of β-glucan. This would be helpful in segregating higher β-glucan fractions for formulating flours to meet health claims.

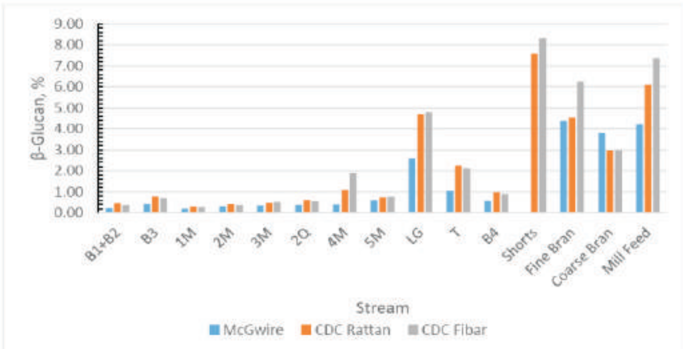

Fig 9. Comparative β-glucan levels of flour streams from wheat and barley (60/40) blends

Roller milling systems have been used under laboratory environment demonstrating higher levels of β-glucan concentration in flour streams (Izydorczyk et al., 2003).

A better idea of the levels of β-glucan at varying flour yields can be obtained by observing the cumulative β-glucan curves for various barley types at 60/40 blend levels (CWRS/barley) (Figure 10). As noted from Figure 10 there is a difference in β-glucan contents for same level of flour yields among the three barley types. For comparative purposes Figure 11 includes the cumulative β-glucan curve prepared for blend of McGwire with CDC Rattan (50/50). When comparing the cumulative β-glucan curve of pure barley blend (McGwire and CDC Rattan) with barley co-milled with wheat at the 60/40 blend level a big difference is observed as these have 60% of wheat in the blend. The cumulative β-glucan curve is plotted by listing the flour streams in descending levels of β-glucan content against their respective flour stream yield percentage. The β-glucan levels are accumulated on weighted average basis and is plotted on Y-axis while the flour yield % is also accumulated and plotted on X-axis. This graph provides an easy reference to millers to assess the β-glucan content at any flour yield level.

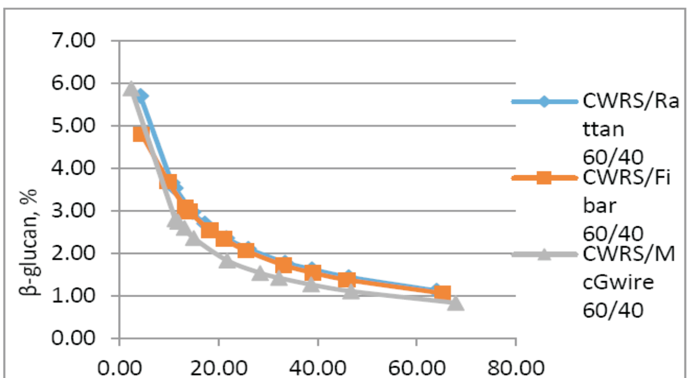

Figure 10. Cumulative β-glucan – wheat / barley blends

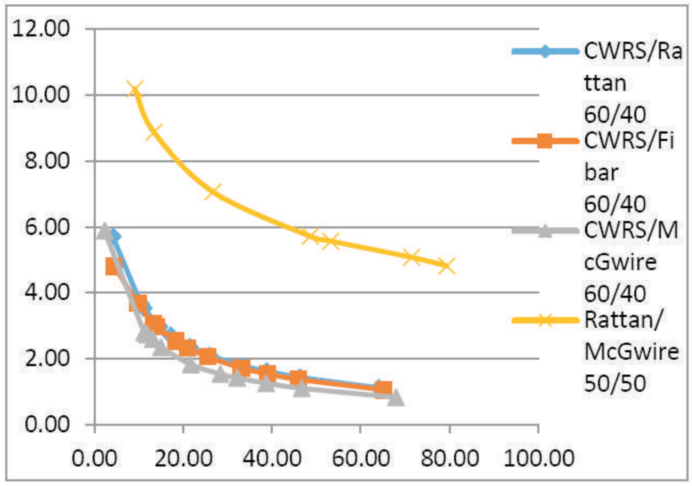

Figure 11. Cumulative β-glucan – wheat / barley & barley blends

While the above is of interest in order to ascertain β-glucan content from a nutritional and ultimately health claim standpoint, evaluating the functionality of the flour for end use application is of equally great importance. Dough handling properties of the blended flours are assessed appropriately by evaluating the Farinograph data on the flours. Table 3 shows the data including the water absorption and stability as well as the dough development time and mixing tolerance index. Figure 12 shows the Farinograph curves. When the percentage of barley in the blend increases the dough begins to weaken as expressed by short stability and declining mixing tolerance. The water absorption also tends to increase as the percentage of barley in the blend increases. The water absorption increases more in waxy barley types than the regular starch barley (McGwire). Although the weakness in dough strength is clearly observed these weaker doughs still exhibited suitable strength for baking. Clearly the blends with waxy barley show greater weakness relative to the blends with regular starch.

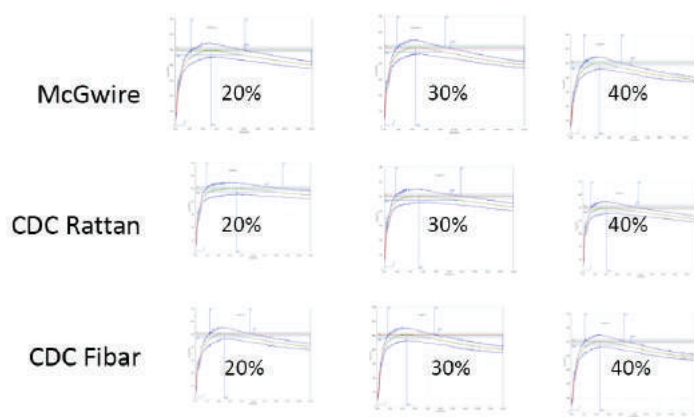

Figure 12. Comparative Farinograph curves for all wheat/barley blends

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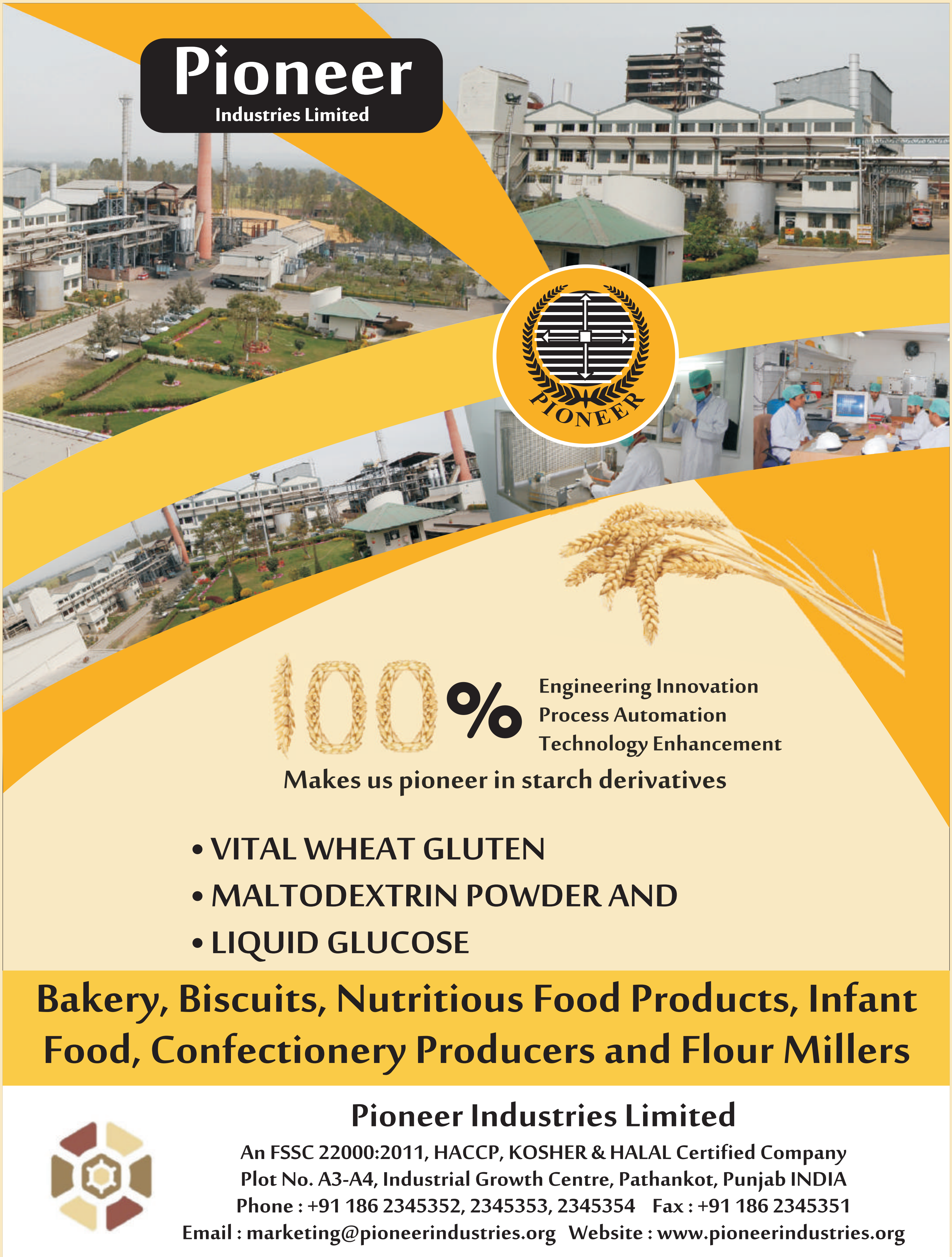

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