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Review Article

# YAVA (*HORDEUM VULGARE* LINN.): A REVIEW

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**ABSTRACT**

Ayurvedic texts glorify the concept of Aahar (food). Acharya Kashyap has quoted that there is no medicine like food. Only a well-balanced diet can cure numerous diseases, sometimes even good medicines are unable to cure certain diseases without balanced diet, that's why food is said to be most important medicine. Today there is increasing public awareness of the importance of diet for the maintenance and promotion of health. A properly selected diet and diet plan plays a critical importance in the management of any disease. Yava is a cereal using since ancient period. It not only provides nutrition but also having many medicinal properties too. This paper reviews the botanical identity of Yava, its traditional, folklore uses, action, pharmacological activities along with agronomy practices.

**Keywords-** Yava, Barley, *Hordeum vulgare Linn.cereal*

## INTRODUCTION

Yava (*Hordeum vulgare Linn.*), commonly known as barley, belongs to family Poaceae. Yava is famous shukadhanya (cereal) used in Indian systems of medicines viz., Ayurveda and used in different medicinal preparations as well as in dietary form for many *santarpanajanya roga* like *prameha*(diabetes), *kustha* (leprosy) and *medoroga* (obesity) etc. for *lekhana karma*[1] . Its origin is considered in Middle East, Domestication occurred in Mesopotamia some 10,000 years ago. It spread to ancient Egypt, Ethiopia and ancient Greece at an early date. Wheat replaced barley as the staple food in classical times[2].

**Yava in Veda and Purana-** There is detailed description of Yava in *veda, araṇyaka, ypanishaḍa, grihya sutra* and *shatapata brahmaṇa*. It is considered as the most ancient cereal in Atharva Veda and also elaborated its feature as '*dirgashuko dhanya vishesha'*. Various purana enrols the yava in religious ceremony/ rituals, *gramaranya* (rural as well as wild), food material. It is used. There is a description of yava as diet as well as in some medicinal formulation and for care of plants; in the decaying of fruits, trees should be served with water mixed with various cereals, sesame seed and yava in agni purana[3 4].

**Yava in Ayurvedic text** -There is detailed description of yava in various ayurvedic samhitas and nigantus. It is kept under *shukadhanya varga* in charak samhita[5], sushurta samhita[6] and astanga hridaya. Acharya Vagabhata was the first to give the concept of *Vichitra pratyarabdha drayya* and given yava as an example of this[7].

**Vernacular Names-** Hindi- Jau; Sanskrit- Yava; Bengali- Jau, Jav; Marathi- Cevad, Jav, Java, Satu; Gujrati- Cheno, Jau; Telugu- Barlibiyam, Dhanyabhedam, Pachchayava, Yava; Malayalam- Javegambu; Punjabi- Javo, Jawa, Nai; Tamil- Barliyarisi, Barliyarishi[8]

**Ayurvedic Pharmacodynamics [5-8]**
The five aspects of Pharmaco-dynamics described in Ayurveda are Rasa (Taste present in the Drug), Guṇa (Properties), Virya (Potency) Vipaka (Final Taste after the digestion of the Drug) and Prabhava (Specific Effects). The action of a drug is completely based on the Rasapancaka of that drug. The rasapanchaka of yava is as follows-
**Rasa-** Madhura, Tikta, Kashaya
**Guna-** Ruksha, Pichhala, Mṛidu, Anabhiṣyandi, Sara
**Virya-** Sheeta
**Vipaka-** Katu
**Doṣaghnata-** Kaphapittahara, Vatakara
**Mala prabhava-** Bahupuriṣakara, Mutra dosha hara
**Karma-** Lekhana, Medovatahara, Medha vardhaka, Vṛiṣya, Balya, Sthairyakṛta, Varṇya, Swarya, Agni/agnidipana, Kasa-swas-pinasa har, Kanṭha rogahara, Tṛiṣa hara, Twaka roga hara, Vraṇepathyam and Urusthambahara.

**Botanical Description**
Yava,*Hordeum vulgare* Linn. is an annual, erect, stout and tufted grass, reaching a height of about 0.5-1.2 m. Roots are fibrous, 0.5 to 0.1 cm thick, cylindrical, glabrous and grayish brown in colour; a clasping leaf is developed at each node. Leaves are few, linear- lanceolate in shape about 15 to 25cm long, yellowish- grey in colour, upper one is close to the spikes and its sheath is striate and ligules are short and membranous. Stem is Cylindrical, 0.4 to 0.6 cm thick, slightly flattened and smooth. It is hollow between nodes and develops five to seven nodes below head. Nodes are short and bearing sheath. Internodes are long and shining yellowish in colour ; spike is terminal, linear-oblong, compressed; 5-6cm long and densely

flowered. Glumes are two, small, narrow; short awned and enclosing three spikelets. Hordeum vulgare is six row variety, where all three of the spikelets at each node develop a seed. The spikelets are sessile and are arranged on two sides of a flattened rachis. There are two long narrow bracts, parallel to each other, considered as glumes. Behind these; solitary flower is inserted, enveloped in lemma (inferior palea) and palea (superior palea). The lemma is broad, rounded on back, 5 nerved and with a barbed awn. The innermost bract known as palea (superior palea) is less obvious, narrow and mostly covered by enveloping lemma. Its fruit is caryopsis, elliptic, 9 cm long, short pointed, smooth and free or adherent to palea or both to lemma. The grains are tightly enclosed and adhering the lemma and palea.Flowering and fruiting is during February-April.

**Chemical composition**

**Seeds-** Cyanogenic glycoside characterized as 2- β-D-glucopyranasyloxy – methyl – (2R) – butyronitrile, ubiquinones,proanthocyanidins, glycosides of hordatines A & B, procyanidin B3, trimer of procyanidin C2, prodelphinidin, chrysoeriol, hordeumin, pangamic acid, protein, carbohydrates, calcium, phosphorus, iron.

**Leaves-** Arabinogalacto (4 - 0 – methyglucurono ) – xylan , cyanogenic glucoside, 6'' – sinapolysaponarin, 6''-feruloylsaponarin and 4' – glucosyl – 6'' – sinapolysaponarin, 2''- 0- glycosylisovitexin.

**Whole plant-** p- coumaroylagmatine, hordenine and its derivative, pyrrolidine, luteolin glycoside, flavones glycosides-orientoside and orientin, cynoglucosides-3- beta- D – glucopyranosyloxy- 2- methylpropene, 4 – beta – D – glucopyranosyloxy – 3- hydroxyl – 3- hydroxymethy-butyrobitrile[9 10].

**Traditional medicinal uses in different countries**

**Afghanistan:** Flowers are taken orally by females for contraception[11].

**Argentina:** Decoction of the dried fruit is taken orally for diarrhea and to treat respiratory and urinary tract infections[12].

**China**: Decoction of the dried fruit is taken orally for diabetes[13].

**Egypt:** The fruit is used intravaginally as a contraceptive before and after coitus. Fifty-three percent of 1200 puerperal women interviewed practiced this method, of whom 47% depended on indigenous method and/or prolonged lactation[14].

**Iran:** Flour is used as a food. A decoction of the dried seed is used externally as an emollient and applied on hemorrhoids and infected ulcers. A decoction of the dried seed is taken orally as a diuretic and antipyretic and used for hepatitis, diarrhea, scorbutism, nephritis, bladder inflammation, gout, enema, and its tonic effect. Decoction of the dried seed is applied to the nose to reduce internasal inflammation[15].

**Italy:** Compresses of boiled seeds are used to soothe rheumatic and joint pains[16]. Infusion of the dried seed is used as a galactogogue[17].

**Korea:** Hot water extract of the dried entire plant is taken orally for beriberi, coughs, influenza, measles, syphilis, nephritis, jaundice, dysentery, and ancylostomiasis; for thrush in infants; and as a diuretic. Extract of the dried entire plant is used externally for prickly heat[18].

**United States:** Infusion of the dried seed is taken orally for dysentery, diarrhea, and colic and for digestive and gastrointestinal disorders[19].

**Actions and Uses:** The seeds are astringent, demulcent, refrigerant, emollient, and diuretic, intellect promoting, aphrodisiac, digestive and tonic. They are useful in catarrhs of throat and urinary tract, cough, asthma, strangury, amentia, fever, burning sensation, urocystitis, dyspepsia, vomiting, gastric disorders, abdominal pain, erysipelas, leprosy, obesity, filaria, defects of vision, ulcers, burns, cephalalgia, anemia and used in the diet of invalids[20].

**Folk uses in India:** Traditionally, the *sattu* is used in the form of gruel in painful and atonic dyspepsia in various parts of the country. A malt extract is prepared by boiling 30-120 g of its germinated grain sin 500 g water and then strained to form a decoction. When hops are added, the decoction becomes wort and acquires tonic properties, which have been found valuable in cases of debility following on long continued chronic suppuration. Besides, tribal people of *Sonbhadra* district in Uttar Pradesh, prepare a decoction of its 2 grains along with the stem bark of *Holarrhena antidysentrica Wall.* and black pepper. About 2 teaspoonsful of this decoction are given to the patient twice a day for seven days to cure malarial fever[9].

**Review of some Pharmacological and Clinical activities**

**Antihypercholesterolemic activity:** Fiber (nonstarch polysaccharides), administered to 21 men with mild hypercholesterolemia aged 30–59 years for 4 weeks, produced a significant fall in plasma total cholesterol and LDL cholesterol. The triglyceride and glucose concentrations did not change significantly[21].

**Cholesterol biosynthesis inhibition:** The inhibitor I from oily nonpolar fraction of flour, administered to chicken at a dose of 2.5–20 ppm, produced a significant decrease in hepatic cholesterogenesis and serum total and LDL cholesterol and an increase in lipogenic activity[22].

**Diuretic activity:** Decoction of the dried seed, administered nasogastrically to rats at a dose of 1 g/kg, produced strong activity[23].

**Fatty acid synthase inhibition:** Petroleum ether extract of the fresh fruit, administered to pigs at a concentration of 3.5 g/kg of diet for 29 days, was active on hepatic enzymes[24].

**Glucose tolerance effect:** Fiber, administered orally to type 2 diabetic Goto– Kakizaki male rats for 9 months, improved the area under the plasma glucose concentration time curves, lowered the fasting plasma glucose and glycosylated hemoglobin levels, and decreased plasma total cholesterol, triglycerides, and free fatty acid levels[25].

**Hypocholesterolemic activity:** Flour, administered orally to adults with hypercholesterolemia at a dose of 44 g/day, produced a decrease of total and LDL cholesterol levels[26].

**Hypotriglyceridemic activity:** Fixed oil of the bran, administered orally to adults of both sexes at a dose of 30 mg/day, was active. Flour bran, administered orally to adults at a dose of 3 g/day, was inactive[27].

**Laxative effect:** Powdered dried bran, administered orally to 44 adults at a dose of 30 g/person, was active on gastrointestinal motility. Transit time decreased by 8 hours, and fecal mass increased by 48.6 g/day[28].

**Lipid metabolism:** Fiber, administered orally to male type 2 diabetic Goto– Kakizaki rats for 9 months, improved the area under the plasma glucose concentration time curves, lowered the fasting plasma glucose and glycosylated hemoglobin levels, and decreased plasma total cholesterol, triglycerides and free fatty acid levels[29].

**Allergenic activity (Contraindications):**

Two cases of severe systemic reactions resulted from beer ingestion: one case of anaphylaxis requiring emergency care and one of generalized urticaria and angioedema were reported. Barley was recognized as the specific ingredient responsible for the observed allergic reaction[30].

A 50-year-old man, who developed bronchial asthma after exposure to barley flour, was confirmed by skin prick test and serum-specific IgE. Bronchial challenge test with every allergen showed no response, except for an immediate response to barley flour. The most relevant clinical feature was an immediate

asthmatic response developed after oral provocation with either barley-made beer or barley flour itself that indicated IgE-mediated food-induced bronchial asthmaHV195. A 32-year-old storeman developed occupational asthma resulting from barley grain dust in the packaging of flour, barley, and peanuts. He developed immediate symptoms of sneezing, cough, and dyspnea on exposure to barley only. Bronchial provocation test to the barley confirmed the diagnosis[31].

**Agronomy**

**Climate:** Barley is a crop of temperate climate; it thrives best in areas having cool dry winters with low rainfall. The growing period in the plains lasts for about 5 months, which may extend up to 6-7 months in the medium to higher hills. (1500 -2500 m elevation) .The crop can withstand cool humid and warm dry climates, but hot humid climate disfavors its growth, mainly due to prevalence of diseases. In the plains of eastern, central and peninsular India, where the winters are mild, the growing period is reduced to 3-4 months. In any given region, barley matures 2-3 weeks earlier than that of wheat and other rabi cereals, indicating its lower requirement of heat to reach maturity and thus it is also inherently equipped to escape drought.

**Soil:** Barley thrives best on well drained fertile loam or light clay soils. Severe lodging occurs on highly fertile soils with excess of nitrogen, which in turn also increases the nitrogen content in the grain, rendering it unsuitable for malting. In India, barley is grown as a wide variety of soils ranging in texture from sandy to heavy loams in the Indo- Gangetic Plains and on the terraced slopes in the hills. Its cultivation also extends to a limited extent on the black soils of Karnataka. Barley is more tolerant to a saline – alkaline soils and less to acidic soils when compared with other cereals. It is more favoured under these conditions in Rajasthan, Haryana, Bihar, Uttar Pradesh and West Bengal. It was found to be a successful crop on coastal saline soils of Sunderbans in West Bengal.

**Crop rotation:** It is generally grown in rotation with pearl millet (bajra), maize, rice, cotton, groundnut, green gram and moth bean in different part of the country.

**Sowing time:** Barley can be grown under a wide range of sowing dates determined by differences in latitude, altitude, climatic conditions and cropping systems. It is the only cereal whose cultivation extends to northern latitudes at 70°N (Norway) and at latitudes up to 5,000 m in the cool arid regions of the Himalayas. As barley requires lesser units of heat to reach its physiological maturity, its cultivation extends to high altitudes where the summers are too cool for the cultivation of rice and maize and too short for the cultivation of wheat and Oats. In plains and upto elevation of 2,300 m in the hills, it is grown as rabi crop. The normal sowing time extends from middle of October to end of November, depending upon the elevation, temperature, soil type and moisture status. Under irrigated timely sown conditions, barley has an additional niche in areas with saline water fo irrigation. Delayed sowing leads to considerable reduction in grain yield and production of poor quality grains are unfit for malting. Under rainfed conditions, sowing should be completed by the last week of October, when the mean temperature falls to 23° C to 25°C.Sowing should be so timed as to ensure the maximum use of conserved soil moisture as well as to avoid high temperature. Before this time, high temperatures can lead to etiolation and seedling mertality. Under irrigated conditions the ideal time for barley sowing is from first to third week of November. Delay in sowing beyond this time, leads to decline in grain yield through reduction in tiller number and grain weight per spike. It also raises the protein content of the grain, thereby adversely affecting the malting quality. As it is a short duration crop, with the availability of early maturing varieties, it can be grown successfully under late sown conditions to fit into cropping patterns, particularly after very harvest of the preceding crops, viz paddy, cotton and potato, up to the end of December to first week of January. It is possible for barley in the plains of Bihar, eastern Uttar Pradesh, Punjab and West Bengal. At elevations above 2,300m,barley is grown as an irrigated crop in spring season. The sowing time extends from the end of April to the end of May, depending on factors, viz. the time of melting of snow from fields, suitable soil temperature to ensure good germination and stand and availability of irrigation water. In Nilgiris and Palni hills of Tamil Nadu, it can be grown all year round. It is sown either in May – June or August-October, depending on the altitude and pattern of rainfall. In the non-traditional hilly areas of North Ascot district with elevation of 600-700 m above mean sea level, successful crop of barley has been possible during mid November to mid February with suitable varieties under irrigation.

**Cultivation practices**

**Land preparation:** Barley does not require a very fine seed bed preparation and therefore 1 ploughing with a soil turning plough, leveling and 1 harrowing are enough for sowing. Levelling helps in uniform distribution of seed, fertilizer and irrigation water.

**Seed treatment:** To protect the crop against white ants and soil borne pests, seed treatment with Chlorpyriphos @4.5 ml/kg seed or Endosulphan @ 7 ml/kg seed and the seed should be dried overnighy to sowing, before the last discing. Soil infested with nematodes requires 2 to 3 deep summer ploughings to reduce their populations. Covered smut and loose smut can be controlled by seed treatment with either of Vitavax, Benlate and Bavistin @ 2 g/kg seed before planting. Dry seed treatment with 0.25% Caboxin would control loose smut. Seed treatment with Oxycarbixin 0.25% is recommended for the control of yellow rust. Among the insect pests, aphid (Rhopalosiphum maidis) is the most serious pest of barley. Spray of Methyl demeton 25 $_{EC}$ or Dimethoate 30 $_{EC}$ at 1,000 ml/ha or Imidacloprid 200 $_{SL}$ at 100 ml/ha should be applied in 200-250 litres of water per ha.

**Seed rate:** Agronomic experiments conducted under the All India Co – ordinate Barley Improvement Project indicated that seed that a seed rate of 75-80 kg/ha may be used for irrigated timely sown, whereas a seed rate of 100 kg/ha is suitable for irrigated late sown and saline alkaline soils. For rainfed areas, a seed rate of 80-100 kg/ha should be used depending on soil moisture status at the sowing. In the cool arid region of Ladakh a higher seed rate of 250-30kg/ha may be used.

**Method of sowing:** Seeds are sown either by broadcasting or with a single tube drill (pora, magha or sadde). Broadcast method (chitta) is following in eastern Uttar Pradesh, Bihar and diara lands (after recession of floods). The suggested spacing between rows is 22-23 cm under irrigated condition and 23-28 cm under rainfed condition. The optimum seed depth for sowing is 3-5 cm under irrigation and 5-8 cm under rainfed condition, depending on the initial soil moisture. In clay soils with tendency to crust, shallow planting is preferable. Deep seeding is detrimental, and it delays and reduces total emergence.

**Irrigation:** Barley crop needs 2-3 irrigations. One or two extra irrigations are needed on sandy soils. Light and frequent irrigations to barley on sandy soils are more advantageous than little irrigation. Barley has 3 critical growth stages for irrigation, viz. active tillering stage (30-35 days after sowing), flag - leaf stage (60- 65 days after sowing) nad milk stage (80-85 days after sowing). Active tillering stage is the most crucial. If only 1irrigation is available, it should be applied at active tillering stage and the other at the flowering stage.

**Manuring:** Application of fertilizers and manures to barley crop enables proper utilization of available moisture to exploit full yield potential of a variety. However, rainfed crop of barley is seldom manured directly. It is the preceding kharif crop that

receives manure. With major shift in the pattern of cultivation towards more remunerative crops over the past two decades, very little or no manuring is normally given to coarse cereal crops including barley. Nitrogen fertilization is essential for obtaining high yield from barley crop particularly on soils with lower organic matter, following a non leguminous crop. Agronomic experiments indicate that barley responds well to an application of 40-60 kg N/ha under rainfed condition and 60-80 kg/ha under irrigated condition, depending on the climate, soil and variety. Good response to phosphorus up to 30kg/ha was obtained under irrigated condition.

**Interculture:** Weeds generally pose greater problem in irrigated areas, though barley is known to be a good competitor of weeds. Both broad leaf weeds (*Chenopodiem album*) and narrow leaf weeds (*Phalaris minor* and *Avena ludoviciana*) are common in barley. To prevent losses from weeds, 1 hand- hoeing after first irrigation is quite useful. Weeds can be controlled by application of suitable weedicides. Wild Oats and *Phalaris minor* can be controlled by pre – sowing application of Pendimethalin @ 1.0 – 1.5 kg a.i. / ha on prepared top soil. 2, 4 – D and Metsulfuron can be applied as tank mix application with isoproturon as post emergent weedicides is used to control of complex weed flora

**Harvesting, threshing and yield:** The harvesting time depends on the total duration of crop in a tract. Harvesting in the plains of Jammu, Punjab, Haryana, Rajasthan and western Uttar Pradesh takes place from third week of March to middle of April. In Madhya Pradesh, southern and eastern Uttar Pradesh, Bihar, Orissa and West Bengal it starts 7 to 10 days earlier. In Maharashtra, Gujarat, Karnataka and Tamil Nadu (North Arcot , low hills ), it can be harvested by the first week of February. In the hills, where it is grown in rabi, the harvesting time varies from the end of April to end of May, depending upon the altitude. The spring sown crop is harvested from the end of April to end of July to the end of September. In the Nilgiri and Palni hills in southern India, the summer crop sown in May – June is harvested by end of August to first week of September – October. In the higher altitudes of Leh and Kargil in Jammu & Kashmir, a short duration crop planted in May can be harvested by end of August to first week of September. The harvesting is usually done by sickle, when ripe. Barley is more prone to shattering than wheat. Therefore, to prevent losses from shattering, it is useful to cut the crop in early hours of mornings. Harvest it before it is dead ripe. In the plains the threshing was done by treading the dry produce under the feet of cattle or by running the tractor over the heaps of harvested crop but now the use of the tractor operated threshers is common. The crop with large areas is also harvested with combine by the more progressive farmers. Special care is needed to ensure least skinning and breaking of barley grain during threshing by adjusting the speed of thresher. The average yield of rainfed crop ranges between 2,000 and 2,500 kg/ha, whereas that of irrigated crop is twice as much. Under favourable conditions of manuring and management practices, improved varieties are capable of giving grain yield of 5-6 tonnes / ha under irrigated timely sown conditions, from 3 to 3.5 tonnes / ha under late sown conditions and from 2.5 to 3 tonnes / ha under rainfed conditions.

**Storage:** The grain should be thoroughly dried before storage. The store rooms, storage - pits or bins should be moisture proof as barley is hygroscopic and should be fumigated to keep away the stored grains pests. Grains stored with more than 14% moisture become warm and deteriorate and thus become unsuitable for malting.

**Grading and Marketing:** Grading and marketing standards are usually established by the government agencies in each country to provide a method to differentiate the quality and value of the produce. At present there are no commonly recognized standards of quality in the internal market in our country and grading is not strictly practiced. However, there are well set grade requirement for both 6 – rowed barleys and 2-rowed barleys in many other parts of the world. These grades are basedon minimum and maximum limits for a number of factors, viz. percentage of healthy bold grains, proportion of damaged kernels, foreign matter, other grains and the skinned and broken grains. There are very well recognized and well defined grade standards for good malting quality barleys.

**Varieties:** The All India Co – ordinate Research Project on Barley Improvement (presently Barley network under Directorate of wheat Research) has since its inception devoted efforts to develop improved varieties for human consumption ( hull – less ) ,dual purpose fodder –cum –grain types for animal ( feed or fodder ) ,and 2 – rowed and 6 – rowed hulled types for malting and brewing industry. BH 393, DWR 28, RD 2592, NDB 1173, Malty (DL 88) , RD 2624, RD 2508, Haritma (K 560) RD 2052, Vijay( M 130), Himadri (BHS 352) VLB 56 are some common varieties used all over India[32].

## CONCLUSION

It is a time to reintroduce the Barley again in main diet due to its high nutritional value. It can be good substitute of carbohydrate, protein, fibres and minerals in diet. This cereal can play important role in diet as well as it is indicated as patya in many diseases.

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