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Use of sprouted grains in the diets of poultry and ruminants

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ABSTRACT

Sprouting has been used to improve the nutritional value of the grains. The nutritional value of sprouted grains is improved due to the conversion of complex compounds into relatively simpler compounds that are nutritionally more valuable. Sprouting of grains has resulted in increased protein quantity and quality. Sprouting also increases the concentration of certain nutrients including sugars, minerals and vitamin contents. However, sprouting has resulted in decreased starch contents and dry matter content of grains. It also increases the plant enzyme contents. Various studies on the use of sprouted grains suggested either no effect on feed intake or a reduction in feed intake. Sprouted grains may improve weight gain in broilers by up to 8%. Digestibility of nutrient has been increased by using sprouted grains in the diet of broilers and large animals. This is achieved possibly by changes in rate and extent of digestion and absorption. During germination enzymes are produced which reduces viscosity of the digesta and improves the digestion and absorption of nutrients. This is also due the presence of grass juice factor which is a good source of nutrients. Use of sprouted grains in the diet of layers has also reduced egg production. It is reported to increase feed efficiency in terms of kg feed consumption for one kg egg production. Addition of sprouted grains has improved milk yield up to 8.7% in ruminant animals.

Keywords :

Introduction

Cereal grains are used as foodstuff for human and animals since many years. To get maximum nutrients cost effectively from these grains, different treatments have been applied e.g. sprouting, fermentation, heat treatment etc. (Finney, 1982). The trend of using sprouted grains in poultry diet is increasing due to many reasons. For example sprouting is a simple technique to germinate the seeds for the improvement of their nutritive value (Amal et al., 2007).

Nutritional value of sprouted grain improves due to the conversion of complex compounds into simpler and essential form and by minimizing the effect of antinutritional factors during germination (Chavan and Kadam, 1989). Sprouting of grains can be used advantageously as it has resulted not only in increased protein quantity but quality also. This is further complemented by increased sugars, certain minerals and vitamin contents. However, sprouting reduces total starch and dry matter content of grains (Lorenz, 1980). It has also increased the plant enzyme contents (Shipard, 2005).

During germination protease enzymes are activated that convert the protein polymers into amino acids and small peptides (Shewry *et al*., 1995). These enzymes convert the complex compounds of protein into albumin and globulin thus, improve the quality protein. They also improve the lysine content of grains (Chavan and Kadam, 1989). Activation of amylase and lipase during germination increases the sugar and essential fatty acid content of grains (MacLeod and White, 1962; Chavan and Kadam, 1989).

During germination vitamin contents especially B-vitamins, vitamin E and β-carotene (Vitamin-A precursor) are increased many fold. Cudderford (1989) reported that vitamin contents of sprouted grains can be improved up to 20 times (Cuddeford, 1989). During sprouting minerals are merged (Chelate) with protein and increased their function. Germination eliminates the effect of phytic acid by the production of phytase enzymes (Shipard, 2005).

Sprouted grains contain grass juice factor which is a rich source of nutrients. The juice factor has been reported to improve the performance of birds and animals (Finney, 1982; Nutrigrass, 2007). Several studies have indicated the importance of the feeding value of sprouted grains for poultry and ruminants. Various different studies reviewed including that of Bull and Peterson (1969), Farlin *et al.* (1971), Rowland *et at.* (1978) and Sibbald *et al.* (1962) reported no difference in the performance of poultry birds fed sprouted and non-sprouted grains. However, Falen and Peterson (1969) reported that metaboliseable energy contents were increased when birds were fed the combination of both sprouted and nonsprouted grains. Leitch (1939) observed increased weight gain of up to 200 g per day in beef cattle by adding sprouted grains in beef rations. Fayed (2011) determined that addition of sprouted barley in the diet of lambs improved the performance. However in another study reported by Farlin *et al.* (1971) no difference in weight gain and performance of beef cattle by the addition of sprouted grains was observed. The inconsistency in the beneficial effects sprouting warrants further careful studies to include the animal effects.

Table1: Effect of sprouted grains on nutrient contents of grains

Type	DM %	Ash %	OM %	CP %	NDF %	ADF %	WSC %	NFC %	Ca %	P %	Fe	Reference
Barley												
Grain	91.4	2.81	97.19	11.73	20.2	7.2	3.76	64.6	0.26	0.42	96.1 (mg/kg)	Fazaeli *et al., 2012*
Sprout	14.35	3.72	96.28	13.68	31.8	15.5	6.26	45.7	0.39	0.44	147	

Grain	90.5	2.0	-	12.6	-	-	-	-	0.03	0.22	39.6 (µg/g)	Dung et al., 2010
Sprout	15.1	4.3	-	15.4	-	-	-	-	0.06	0.26	52.0	
Grain		2.6	-	10.5	-	-	-	-	0.18	0.48	-	Moghaddam et al., 2009
Sprout		2.6	-	12.15	-	-	-	-	0.48	0.59	-	
Grain	100	2.79	-	12.7	-	-	-	-	0.03	0.52	63 (mg/kg)	Peer and Leeson, 1985
Sprout	81.7	3.2	-	12.6	-	-	-	-	0.033	0.47	75.1	
Grain	90.4	3.40	96.6	10.45	22.5	8.9	3.5	61.5	0.26	0.35	125 (mg/kg)	Fazaeli *et al., 2011*
Sprout	19.2	3.65	96.35	13.69	31.2	14.3	6.4	49.0	0.32	0.43	237	
Grain	89	2.1	88.8	10.1	-	-	-	-	-	-	-	Sneath and McIntosh, 2003
Sprout	84	5.3	88.4	14.9	-	-	-	-	-	-	-	
Wheat												
Grain	-	0.97	-	10.77	-	-	-	84.6	0.10	0.13	30 (mg/kg)	Steve, 2012
Sprout	-	0.97	-	13.50	-	-	-	82.1	0.15	0.29	55	

Effect of sprouted grains in poultry

Effect on feed intake

Although sprouting of the grains has been reported to increase the nutritional value of the grains, the effect on feed intake is not very encouraging. For example Hamid, (2001) reported that the addition of sprouted grains in the diet of broilers lowered feed consumption. This was also confirmed by Abbas and Musharaf, (2008). However, it has been observed that its not the sprouting but the level of sprouted grains used that might be responsible for reduced intake (Fafiolu et al. 2002). In this study inclusion of sprouted sorghum in the diet of layer hen at the level of 300 g per kg of diet reduced feed intake but 150 g per kg diet did not affect the intake. The reduced feed intake is probably due to reduced palatability, taste or smell. According to Oduguwa and Farolu, (2004) feed intake was reduced in broiler birds because sprouting caused bitterness in taste. Anganga and Adogla- Bessa, (1999) pointed that decrease in feed intake was due to the presence of tannins which depressed palatability. There are certain studies that report no reduction in feed intake. For example Scott, (2002) and Fafiolu et al. (2006) determined that feed intake was not affected by the addition of sprouted grains in poultry diet. The above studies indicate that sprouted grains can be successfully used in the poultry diet without affecting intake provided birds are not put off due to poor palatability, bitter taste or bad smell.

Effect on growth performance in broilers

As sprouting increases nutritional value of grains, it should increase the performance if it does not depress intake. This has been confirmed by various studies that reported increased weight gain and better feed efficiency. Soaking of barley grains for 16-24 h in water and drying before addition into poultry diet improved weight gain of up to 8% (Adams and Naber 1969). Willingham et al. (1959) also observed improved growth performance of broiler birds by giving water treated barley based diet. Similarly Anderson et al. (1961) observed 12% improvement in weight gain. Bamforth et al. (1982) reported that, this improvement of nutritive value of barley were due to the activation of endogenous enzyme β-glucanase by water treatment which limited the activity of glucans. Nutritive value was also improved due to structural alterations of starch (Fry et al., 1957, 1958; Potter et al., 1965). An other important factor to include is the number of days of germination. For example Hamid (2001) reported that 3 days germinated grains improved growth performance.

The positive effects of sprouting on growth performance are not always evident(Scott, 2002; Oduguwa and Farolu, 2004). Lack of response or lower performance reported in some studies has been attributed to either insufficient germination or germinating for a longer period of time that may cause antinutritional factors to become active. Many studies have suggested that water treated grains depressed (Hamm, 1958) or did not affect the growth performance of broiler birds (Newman et al., 1985). Abbas and Musharaf, (2008) determined the effect of days of germination of sorghum grain on the growth performance of broiler birds. They reported that 3 days germinated grains had no effect on the growth performance of broiler birds but when days of germination increased it depressed the growth because tannin contents were increased.

Effect on nutrient digestibility

The improved growth performance reviewed above can be attributed to increase in the nutrient digestibility. Sprouting results in increased availability of enzymes in the grain. The viscosity of the digesta is also modified. The increased nutrient digestibility can be related to changes in the extent and rate of digestion of the nutrients. This is further complemented by increased absorption of the nutrients. During the germination process enzymes are produced that reduce the digesta viscosity and improves the nutrient digestion and absorption (Annison, 1993; Bamforth, 1982). Moghaddam et al. (2009) conducted an experiment to determine the effect of sprouted grains on nutrient digestibility. They replaced barley with sprouted barley at the level of 0, 33, 66 and 100%. They concluded that nutrient digestibility was increased by increasing the level of sprouted barley. They reported that 100% replacement resulted in better nutrient digestibility as compared to other levels. This increase in nutrient digestibility may be due to decrease in the glucans level (Loi et al., 1987; Brunswick et al., 1987) and activation of phytase enzyme during germination (Prentice and Faber, 1981; Bartnik and Szafranska, 1987; Rimsten, 2003).

Effect of sprouted grains on layer performance

No conclusive evidence was obtained about the effect of sprouted grains on the performance of layers. Most of the studies report either no response or lower egg production on sprouted grains. Fafiolu et al. (2006) determined the effect of sprouted grains on the performance of layer during growing and laying phase. They reported that inclusion of sprouted sorghum in the diet of pullets at the level of 0, 150 and 300 g/kg of diet did not affect daily feed consumption, average weight gain and age at first egg during growing phase. Its inclusion had also no significant effect on feed to gain ratio. Similarly Musharaf and Latshow (1991) observed no significant effect on weight gain in layers by the addition of sprouted sorghum. In contrary to this Adebule (2002) observed decrease in weight gain when the level of sprouted grains increased in pullets diet.

During laying phase addition of sprouted grains in the diet of layers reduced egg production. However, feed efficiency in terms of kg of feed consumed per kg of egg produced reduced as the level of sprouted grains increased (Fafiolu et al., 2006). The reduced egg production can be attributed to the presence of dhurrin and tannin in sorghum (Ikediobi, 1989; Aning et al., 1998; Oduguwa et al., 2001; Oduguwa et al., 2005) and reduction in feed intake can be attributed to the bitterness of sprouted grains (Aning et al., 1998, Oduguwa et al., 2001).

Table 2: Effect of sprouted grains in poultry

	Feed intake	Growth performance	Nutrient digestibility	Layer performance	References
Effect of sprouted grains	No effect	No effect	-	↓	Fafiolu *et al*., 2006
	↓	No effect	-	-	Abbas and Musharaf, 2008
	↓	↓	↑	-	Oduguwa and Farolu, 2004
	No effect	No effect	-	-	Scott, 2002
	-	↑	↑	-	Bamforth, 1982
	↓	↑	-	-	Hamid, 2001

Effect of sprouted grains in ruminants

Effect on feed intake

Fazaeli *et al.* (2011) reported that feed intake decreased by the addition sprouted grains in the diet of ruminants. This is attributed to an increase in fiber contents of sprouted grains as compare to whole grain. Feed intake was also reduced due to higher water contents of sprouted grains which make the feed bulky (Hillier and Perry, 1969; Myers, 1974). Fayed (2011) determined that addition of sprouted barley with rice straw and Tamarix Mannifera decreased feed intake in lambs. In contrary to this Eshtayeh (2004) observed non-significant effect of sprouted grains on DM intake. Similarly Rule *et al.* (1986) observed no effect on feed intake in cattle by the addition of sprouted wheat. Reddy et al. (1991) also observed non-significant effect of sprouted grains on DM intake in cows.

Effect on growth performance and weight gain

Leitch (1939) observed increased weight gain of up to 200 g per day in beef cattle by the addition of sprouted grains. Fayed (2011) determined that addition of sprouted barley with rice straw and Tamarix Mannifera improved weight gain in lambs. The addition of sprouted barely with Tamarix Mannifera showed better weight gain than those of on rice straw. This improvement was related to the presence of grass juice factor which contains good source of nutrients (Finney, 1982). Improved performance on sprouted grains has been observed in other studies (Tudor et al. 2003). The lack of response observed in some other studies (Farlin et al. 1971; Rule et al. 1986; Fazaeli *et al.* 2011) has been attributed to lower bioavailability of nutrients. The efficiency of utilization of sprouted grains may be affected by certain factors intrinsic to the grains like type of grain, variety and processing. The period of sprouting and the moisture contents of sprouted grains also affect the efficiency of utilization.

Effect on feed efficiency

Fazaeli *et al.* (2011) observed no significant effect of sprouted grains on feed efficiency and FCR in calves. Similarly Restle et al. (2002; 2003) and Berry et al. (2004) also observed non-significant effect. Rule *et al.* (1986) also observed similar results by dietary supplementation of sprouted wheat. Fayed (2011) determined that addition of sprouted barley with rice straw and Tamarix Mannifera improved the feed efficiency and FCR in lambs. Eshtayeh (2004) also observed improve in feed efficiency when sprouted barley fed with olive cake.

Effect on nutrient digestibility

Nutrient digestibility increased by using sprouted grains in ruminant diet. Fayed (2011) determined that addition of sprouted barley with rice straw and Tamarix Mannifera increased DM, OM, CP, EE, CF, NDF and ADF digestibility. This may be due to the presence of bioactive catalysts which increases digestion and absorption of nutrients. Similarly Shipard (2005) observed increase in nutrient digestibility by the addition of sprouted grains in the diet of ruminants. Morgan et al. (1992) reported that OM and DM digestibility were maximum by the addition of four day old sprouted barely. Peer and Leeson (1985) also observed similar results. Ibrahim et al. (2001) also reported that addition of sprouted grains increase nutrient digestibility.

In contrary to this Dung et al. (2010) have observed non-significant effect of sprouted grains on nutrient digestibility. Flynn and O'Kiely (1986) observed an 8.6% reduction in digestibility of 8-day old sprouts, probably due to increasing fibre content with age. Similarly Sneath and McIntosh (2003) did not observed any difference in nutrient digestibility by the addition of sprouted grains. Hillier and Perry (1969) evaluated the effect of four levels of oat sprouts (0, 0.63, 0.95, 1.26 kg DM) on both low and high-energy diets. They observed no effect on DM, CP, CF, EE and NFE digestibilities.

Milk yield and blood parameters

Mincera et al. (2009) evaluated the effect of sprouted oats in Comisana sheep. They found that supplementation of oats in diet of sheep did not affect the biochemical and hematological parameters, but observed an improvement in animal milk production. Grigor'ev et al. (1986) observed 8.7% improvement in milk yield by replacing 50% corn silage with sprouted barely. Marisco et al. (2009) conducted a parallel study with goats and found no change in biochemical and hematological profiles. Unlike the sheep trial, no change in milk yield was observed between those fed on hydroponic sprouts and those fed on traditional diets. Thomas and Reddy (1962) did not observe any increase in milk production fed sprouted grains to cows that were receiving already sufficient amount of energy but increased the milk production in cows that were not receiving sufficient amount of energy. Reddy et al. (1991) observed non-significant effect of sprouted grains on milk yield.

Table 3: Effect of sprouted grains in ruminants

	Feed intake	Weight gain	Feed efficiency	Nutrient digestibility	Milk yield	References
Effect of sprouted grains	↓	No effect	No effect	-	-	Fazaeli *et al.*, 2011
	↓	↑	↑	↑	-	Fayed, 2011
	No effect	No effect	No effect	-	-	Rule *et al.*, 1986
	No effect	-	-	-	No effect	Reddy *et al.*, 1991
	↓	-	-	No effect	-	Hillier and Perry, 1969
	No effect	-	↑	-	-	Eshtayeh, 2004

Conclusion

Sprouted grains have been used in animal feeding for a long period of time. Sprouted grains results in increased nutrient availability, digestibility and growth in both poultry and ruminants. However, negative effects due to poor intake can be minimized by using appropriate level of sprouted grains in the diet. Animal may be encouraged to increase intake by increasing palatability of sprouted grains.

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