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EFFECT OF DIETARY YEAST SUPPLEMENTATION ON THE PRODUCTION PERFORMANCE OF BROILERS

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ABSTRACT
The study was undertaken to evaluate the effect of yeast supplementation on the production performance of commercial broiler chicken. A total of 288 day old (Cobb 400) chicks were randomly assigned in to four treatments with three replicates which contained 24 chicks in each replicate for 42 days experimental period. The dietary treatments were formulated as a control (T1), 0.1% (T2), 0.15% (T3) and 0.2% (T4) yeast (*Saccharomyces cerevisiae*) in basal feed. The data on production parameters which include weekly body weight and cumulative weekly body weight gain, feed efficiency and livability were recorded. Group supplemented with 0.2% yeast had significantly ($P<0.01$) highest body weight and body weight gain along with best ($P>0.05$) feed efficiency than control group throughout the study period. It was concluded that yeast (*Saccharomyces cerevisiae*) supplementation at the level of 0.2% in broiler chicken diet substantially improved production performance which can be implemented in commercial flocks for better profitability.

KEYWORDS: yeast, broiler chicken, body weight, production.

INTRODUCTION
Modern intensive poultry production produces market ready broiler chickens within six weeks of their age. Feed as a major input item of broiler rearing which occupies 75% of the production cost and has a vital role in broiler economics. The major objective of poultry farming is to increase the profit margin by improving feed efficiency and exploiting maximum growth potential of the birds. Hence, it is imperative to give due attention to proper utilization of feed without adversely affecting the growth or production performance of broilers (Kokje, 1990). The Commercial broiler is one of the fastest growing bird, its growth and development are dynamic processes. In chicken, dramatic changes occur during the development of small intestinal mucosa after hatching, including enterocyte maturation, intensive cryptogenesis and villous growth. This intestinal development influences the growth rate and feed to gain ratio. In recent years, there has been great attention to minimize or completely avoid usage of antibiotics in animal and poultry feeding, as well as an increasing consumer concern for poultry drug residues in meat and eggs. Hence, non-antibiotic alternatives like probiotics, prebiotics, synbiotics and phytobiotic are being used in poultry feed to improve growth and production performance.

Among this, currently, probiotics are being adopted to alleviate the problems associated with the withdrawal of antibiotics from feed. Among the different probiotic organism the *Lactobacillus* and *Saccharomyces* have been most commonly used. *Saccharomyces cerevisiae* (SC), one of the most widely commercialized types of yeast, rich in crude protein (40-45%) and its biological values were high and also rich in vitamin B complex, biotin, niacin, pentothenic acid and thiamin (Reed and Nagodawithana, 1999) has long been fed to animals and poultry. It has been reported (Priya and Babu, 2013; Onwurah *et al*., 2014; Hana *et al*., 2015) that feeding yeast to chicks improves body weight gain and feed/gain ratio. So yeast culture could be an alternative to antibiotic-growth promoter in feed for broiler chicken. Lutful Kabir (2009) stated that the yeast acts by (i) maintaining normal intestinal microflora by competitive exclusion and antagonism (ii) altering metabolism by increasing digestive enzyme activity and decreasing bacterial enzyme activity and ammonia production (iii) improving digestion, and (iv) stimulating the immune system. Considering the importance of yeast, the present study was designed to evaluate the potential effect of supplementation of yeast (*Saccharomyces cerevisiae)* as a natural growth promoter on production performance of commercial broiler chicken.

MATERIALS & METHODS
The Experiment was conducted at the Poultry Research Station, Madhavaram Milk Colony, Tamil Nadu Veterinary and Animal Sciences University, Chennai, located between 13^0-9' and 13^0-15'N and longitudes 80^0-14' and 80^0-24'E with an altitude of 22 meters above mean sea level. Chennai has a hot and humid climate, classified as "Tropical Maritime Monsoon" type. The average annual rainfall is 1300 mm and depends mostly on the North- East monsoon. The average temperature was 28.4^oC during the study period (December 2015 to February 2016). The relative humidity was high throughout the year in range of 65 to 85 per cent.

Experimental Design
The standard recommended commercial broiler diet was prepared as per BIS 2007 broiler standard with similar nutrient composition for all the treatments. The design of experiment is presented in Table 1. The control diet was formulated without supplementation of any antibiotic growth promoter or yeast probiotic (T1). The experimental diets were prepared by supplementing the control diet with

different levels of yeast *Saccharomyces cerevesiae* (Levucell- SB from Venky's) at concentration of $1x10^9$ cfu/gm. The required amount of yeast was weighed and initially mixed with small amount of feed and then mixed with bulk quantity of feed to get the final concentration of 0.1, 0.15 and 0.2 per cent in T2, T3 and T4 respectively which was analyzed by BIS (1999) method in Department of Veterinary Microbiology, Madras Veterinary College, Chennai and found $1x10^9$ cfu/g concentration of yeast *Sacchaomyces cerevisiae*. All the diets were isocaloric and isonitrogenous. The ingredient and nutrient composition of the experimental broiler pre-starter, starter and finisher diet is presented in Table 2.

TABLE 1: Experimental Design

Grou	Treatment	Replicate	No. of Birds
T1	Basal broiler diet (control)	3	72 (24 birds/replicate 24x3)
T2	Basal broiler diet with 0.1% Yeast	3	72 (24 birds/replicate 24x3)
T3	Basal broiler diet with 0.15% Yeast	3	72 (24 birds/replicate 24x3)
T4	Basal broiler diet with 0.2% Yeast	3	72 (24 birds/replicate 24x3)

TABLE 2: Ingredient and nutrient composition of the experimental broiler diet

Name of the ingredient (per cent)	Per cent inclusion level		
	Broiler pre-starter (0-7days)	Broiler starter (8-21 days)	Broiler finisher (22-42 days)
Maize (Corn)	46.1	50.9	55.75
DORB	1.74	-	2.98
Soya bean meal	41.1	38.2	31.50
Oil (Fat)	5.7	6	6.5
Salt	0.5	0.5	0.100
Mineral mixture	2	2	2
Calcite Powder	0.2	0.8	0.250
DCP	1.5	0.5	0.500
Vitamin mix (AB_2D_3K)	0.01	0.02	0.010
Feed additives**	1.15	1.08	0.410
Total	100	100	100
Nutrient composition of the experimental ration			
Crude protein*	23.24	21.98	19.84
Metabolisable energy (Kcal/Kg)+	3012	3097	3204
Lysine+	1.52	1.33	1.21
Methionine+	0.60	0.44	0.42
Calcium+	1.18	1.17	0.96
Av. Phosphorus+	0.54	0.44	0.35

****** - Feed additive includes- Lysine, Methionine, Ultravit M, Perivac plus, Choline chloride and Cosmodot EP.
\+ - Calculated value
* - Analysed value (AOAC, 1997)

Management of Experimental Birds

All chicks were reared up to six weeks of age in an open sided, deep litter house. The chicks were provided with uniform floor, feeder and watered space and were reared under standard and uniform standard managemental conditions throughout the experimental period. Brooding was done in cages having dimension of 75 cm × 50 cm × 30 cm in size from 1-14 days. All brooding arrangements were made well before the arrival of chicks. All the broiler chicks were provided with uniform brooding facilities using 40 Watt incandescent bulb in each cage. During the brooding period, the birds were provided with 0.135 sq.ft floor space and standard feeding and watering space. During growing period the chicks were provided with 0.5 sq. ft (15-21 days) and 1 sq. ft (22-42 days) floor space respectively on deep litter. Feed and water were provided *ad libitum*. Standard managemental practices were adopted in all the experimental groups. Chicks were provided with 24 hours light with 10 lux intensity during the first three days of brooding period followed by 23 hours of light with 5.5 lux intensity till two weeks of age. The vaccination schedule followed is presented in Table 3.

Parameters recorded

Parameters namely Body weight, weight gain, feed efficiency and Livability were recorded. Birds were individually weighed every week up to 42^{nd} day by using electronic weighing balance of 0.1 g accuracy and the weights were recorded. The body weight gain was calculated.

Feed was weighed and fed to birds. Birds were provided *ad libitum* feed throughout the experimental period. At the end of each week, left over feed was weighed back and net replicate wise feed consumption was calculated. The feed efficiency for each replicate was arrived at by dividing average feed consumption by average body weight. Mortality among birds was recorded daily during the experimental period and the cause for mortality was ascertained by postmortem study to know the etiology. Based on this, the per cent livability was worked out.

TABLE 3: Vaccination Schedule

Age	Vaccine	Route and Dose
7th day	Ranikhet or Newcastle disease vaccine- RDVF	Intra-ocular
16th day	IBD Vaccine (Intermediate Georgia)	Intra-ocular
28th day	Ranikhet disease vaccine ("LaSota" strain)	Drinking Water

RESULTS & DISCUSSION

The Effect of supplementation of yeast on Body weight, weight gain, feed efficiency and Livability were presented in **Table 4-7.**

Body weight and body weight gain

Mean weekly body weight of broilers revealed highly significant (P<0.01) differences between yeast supplemented groups and control throughout the study period i.e., from first week to sixth week. The groups supplemented with yeast at 0.2% (T4) level had significantly higher body weights of 161.99 ± 2.47, 472.11 ± 5.01, 803.05 ± 11.04, 1258.13 ±15.14, 1707.60 ± 19.91 and 2129.72 ± 27.27 g at 1st, 2nd, 3rd, 4th, 5th and 6th week of age, respectively, followed by yeast supplemented group at 0.15% (T3), 0.1% (T2) and control group (T1).

In present study, all the yeast supplementation groups (0.1, 0.15 and 0.2%) had significantly higher body weight at all the age groups than control; this result is in accordance with the previous studies of Muthusamy *et al.* (2011), Fathi *et al*. (2012) and Onwuarah *et al*. (2014).

Increase in the body weight of broiler chicken up to 2129 ±27.27 g, 2042 ±26.78 g and 1966 ±26.54 g due to supplementation of yeast at 0.2, 0.15 and 0.1% respectively than control (1936 ±25.61 g) at 6th week of age observed in the present study, is in concurrence with Hana *et al*. (2015), who reported that diet supplemented with 0.1, 0.2 and 0.3% yeast for 42 days had significantly higher body weight (1863 to 2178 g) than control (1760 g) and Neomycin supplemented group (1751 g).

However, present finding is contrary to the report of Adebiyi *et al*. (2012), who found that no significant differences in body weight was observed between control and 1.0 g, 1.25g and 1.5 g/kg yeast supplemented groups at 6th week of age. Similar contrast report was also observed by Aghdamshahriar and Ahmadzadeh (2008) who found that there was no significant (P>0.05) difference in body weight between yeast treatment and control. This might be due to kind of *Saccharomyces* used alive or dead (enriched, non enriched), less concentration of *Saccharomyces.*

It is inferred from the study that the yeast supplementation at 0.2% had consistent effect throughout the study period, from first week to sixth week in improving the body weight, this finding is in agreement with Geo *et al.* (2008) and Afsharmanesh *et al*. (2010). Increment in body weight as increase in level of yeast inclusion observed in the present study, is in agreement with previous findings of Gheisari and Kholeghipour (2006), Shilpa *et al*. (2007), An *et al*. (2010), Chae *et al*. (2012), Reisinger *et al*. (2012), Sherief *et al*. (2012), Naga Raja Kumari and Susmita (2014).

TABLE 4: Effect of supplementation of yeast on weekly body weight (g) of broiler (Mean ± S.E.)

Age (Week)	Treatments				F value
	Control (T1)	Yeast 0.1% (T2)	Yeast 0.15% (T3)	Yeast 0.2% (T4)	
Day old	44.37 ± 0.40	45.42 ± 0.38	45.20 ± 0.38	44.71 ± 0.49	1.31^{NS}
I	149.68^{c} ± 2.31	154.18^{bc} ± 2.13	158.04^{ab} ± 2.43	161.99^{a} ± 2.47	5.05**
II	421.19^{c} ± 5.49	434.91^{bc} ± 5.14	450.11^{b} ± 7.33	472.11^{a} ± 5.01	13.97**
III	752.26^{b} ± 11.09	764.07^{b} ± 10.69	783.84^{ab} ± 14.74	803.05^{a} ± 11.04	3.51*
IV	1163.58^{b} ± 14.09	1177.70^{b} ± 14.55	1206.83^{b} ± 17.13	1258.13^{a} ± 15.14	7.53**
V	1575.48^{b} ± 20.28	1595.04^{b} ± 22.13	1652.89^{a} ± 20.17	1707.60^{a} ± 19.91	8.39**
VI	1936.61^{c} ± 25.61	1966.05^{c} ± 26.54	2042.78^{b} ± 26.78	2129.72^{a} ± 27.27	10.68**

N=6, NS- Not significant, *- Significant (P<0.05), **- Highly Significant (P<0.01).
Mean value within each row bearing common superscripts do not differ significantly (P>0.05)

TABLE 5: Effect of supplementation of yeast on cumulative body weight gain (g) of broiler (Mean ± S.E.)

Age (Week)	Treatments				F Value
	Control (T1)	Yeast 0.1% (T2)	Yeast 0.15% (T3)	Yeast 0.2% (T4)	
0-1	105.32^{c} ± 1.98	108.76^{bc} ± 1.78	112.86^{ab} ±2.10	117.28^{a} ± 2.13	6.66**
0-2	376.80^{c} ± 5.14	389.53^{c} ± 4.77	404.94^{b} ± 7.02	427.49^{a} ± 4.60	15.78**
0-3	707.88^{b} ± 10.71	718.63^{b} ± 10.32	738.70^{ab} ± 14.45	758.60^{a} ± 10.58	3.75*
0-4	1119.25^{b} ± 13.68	1132.17^{b} ± 14.18	1161.78^{b} ± 16.80	1213.75^{a} ± 14.70	7.99**
0-5	1531.15^{b} ± 20.11	1549.51^{b} ± 21.76	1607.86^{a} ± 19.79	1663.22^{a} ± 19.48	8.79**
0-6	1892.28^{c} ± 25.43	1920.52^{c} ± 26.17	1997.73^{b} ± 26.39	2085.31^{a} ± 26.80	11.01**

N= 6, NS- Not significant, *- Significant (P<0.05), **- Highly Significant (P<0.01).
Mean value within each row bearing common superscripts do not differ significantly (P>0.05).

TABLE 6: Effect of supplementation of yeast on cumulative feed efficiency of broiler (Mean ± S.E.)

Age (Week)	Treatments				F Value
	Control (T1)	Yeast 0.1% (T2)	Yeast 0.15% (T3)	Yeast 0.2% (T4)	
0-1	$1.34^{b} \pm 0.03$	$1.32^{ab} \pm 0.01$	$1.28^{a} \pm 0.03$	$1.22^{a} \pm 0.01$	5.33*
0-2	$1.32^{c} \pm 0.04$	$1.26^{bc} \pm 0.03$	$1.22^{ab} \pm 0.01$	$1.15^{a} \pm 0.01$	7.01*
0-3	1.48 ± 0.02	1.46 ± 0.02	1.41 ± 0.03	1.38 ± 0.04	2.59^{NS}
0-4	$1.58^{c} \pm 0.02$	$1.52^{bc} \pm 0.01$	$1.48^{ab} \pm 0.02$	$1.42^{a} \pm 0.03$	10.33**
0-5	$1.74^{b} \pm 0.03$	$1.68^{b} \pm 0.02$	$1.63^{ab} \pm 0.03$	$1.60^{a} \pm 0.02$	5.99*
0-6	$1.98^{c} \pm 0.04$	$1.91^{bc} \pm 0.02$	$1.85^{ab} \pm 0.02$	$1.80^{a} \pm 0.04$	6.68*

N=6, NS- Not significant, *- Significant (P<0.05), **- Highly Significant (P<0.01).
Mean value within each row bearing common superscripts do not differ significantly. (P>0.05)

TABLE 7: Effect of supplementation of yeast on cumulative livability (per cent) of broiler (Mean ± S.E.)

Age (Week)	Treatments				x^2 value
	Control (T1)	Yeast 0.1% (T2)	Yeast 0.15% (T3)	Yeast 0.2% (T4)	
0-1	98.61±1.38	100.0±0	100.0±0	100.0±0	3.00^{NS}
0-2	97.22±1.38	98.61±1.38	98.61±1.38	100.0±0	2.75^{NS}
0-3	94.44±1.38	95.83±0	97.22±1.38	98.61±1.38	5.02^{NS}
0-4	94.44±1.38	95.83±0	97.22±1.38	98.61±1.38	5.02^{NS}
0-5	94.44±1.38	94.44±1.38	97.22±1.38	97.22±1.38	3.67^{NS}
0-6	93.05±2.77	94.44±1.38	97.22±1.38	95.83±2.40	2.17^{NS}

NS- Not significant N= 6

In can be concluded from present study that, improved body weight due to yeast supplementation in broilers are supposed to be induced by the collective effects of yeast including the form of yeast culture (pure) and concentration of yeast, improvement of feed intake and nutrient retention because it is naturally rich source of proteins, nucleotides, minerals and B complex vitamins leads to increased digestive enzymes activity, maintenance of beneficial microbial population (Fuller, 1989) and increased nutrient absorption due to increased villi height.

The mean cumulative body weight gain observed in this study also showed results in favor of inclusion level of yeast at 0.2% throughout the experimental period. Highly significant (P<0.01) difference in mean cumulative body weight gain was observed at every week of age. However, at the end of study period, significantly higher (P<0.01) cumulative body weight gain was noticed in 0.2% yeast supplemented group (2085.31 ±26.80 g) followed by 0.15% yeast fed group (1997.73 ±26.39 g) and 0.1% yeast treated group (1920.52 ±26.17 g) and control group (1892.28 ± 25.43 g).

Present pattern of results due to yeast supplementation is in accordance with previous studies of Oyedeji *et al.* (2008), Paryad and Mahmoudi (2008), Koc *et al.* (2010), Saied *et al*. (2011), El-Naga (2012), Ghosh *et al*. (2012), Abdelrahman *et al*. (2013) and Kumar *et al*. (2013) The birds supplemented with 0.2% yeast had 192g higher body weight gain than control at 6th week of age, similar result was also noticed by Santin *et al*. (2001) who reported that feed supplementation with 0.2% yeast cell walls to Cobb broiler chicken showed 140 g higher mean body weight gain as compared to the control group during 42 days experiment period.

Similar to body weight there were marginal increase in body weight gain at all age groups with ascending levels of yeast observed in this study is in agreement with the results recorded by Zhang *et al.* (2005b), Tabidi *et al.* (2013) and Yalcin *et al.* (2013) who had stated that body weight gains were linearly (P<0.05) increased with increase in yeast level.

The mean cumulative body weight gain of broiler at 6th week due to 0.2, 0.15 and 0.1% yeast supplemented group (2085.31 ± 26.80, 1997.73 ± 26.39 and 1920.52 ± 26.17 g respectively) were higher than control (1892.28 ± 25.43g) of this study is in agreement with previous findings of Al-Mansour *et al*. (2011) (2460 Vs 2119 g) and Priya and Babu (2013) (1643 Vs 1627g). Further, there was noticeable difference observed between control and 0.1% and 0.2% levels of yeast supplemented group (1663.22 ± 19.48 Vs 1531.15 ±20.11 g) even at 5th week of age of this present study, which is in accordance with the report of Kassem and Fayed (2012) who found significant difference in body weight gain of Cobb broiler chicken when fed with the diet supplemented with live yeast at 0.5gm/kg feed (2.143 kg), dry yeast at 1gm/kg feed (2.144 kg) and inactivated yeast (*Saccharomyces cerevisiae*) at 1g/kg (2.351 kg) at 5 weeks of age than control birds (2.048 kg), whereas increased body weight gain at every week of age was noticed in present study when birds diet were supplemented with pure yeast culture yeast at 2 g/kg. The variation in body weight gain observed in this study as compared to previous works might be due to form of yeast (pure culture) and different concentration of yeast (cfu/g) used in this study. Contrary to our findings, Gao *et al*. (2008) observed that body weight gain of broilers was not affected by different levels of dietary yeast culture supplementation (5 and 7g/kg) up to 6 weeks of age and concluded that at higher level, yeast is not able to produce any beneficial effect on body weight gain. Adebiyi *et al.* (2012) also found that there was no significant difference in body weight gain between control and at 1 g, 1.25 g and 1.5 g/kg yeast supplemented groups at 6th week of age.

Significant higher cumulative body weight gain at all the age groups in the yeast supplemented groups observed in this study might be due to beneficial effects of probiotic in the gut, which might have increased the activities of digestive system, resulting in improved digestibility, feed utilization and better body weight gain.

Cumulative Feed efficiency

Mean cumulative feed efficiency of broilers revealed significant (P<0.05) differences between treatment groups throughout the study period in all the weeks (1^{st} to 6^{th}) which is in agreement with previous findings of Abediyi *et al*. (2012), Priya and Babu (2013) and Yalcin *et al*. (2013). At the end of experiment (42^{nd} day), the birds diet supplemented with 0.2% yeast showed better mean cumulative feed efficiency of 1.80 ±0.04 whereas 0.15% yeast fed group shown comparable feed efficiency of 1.85 ±0.02 and the 0.1% yeast fed and control group had recorded poorer feed efficiency of 1.91 ± 0.02 and 1.98 ± 0.04 respectively, this finding matches with earlier reports of Al-Mansour *et al.* (2011), Aluwong *et al*. (2013) and Tabidi *et al.* (2013) who have also reported a better feed efficiency value of 1.8 at highest level (0.3%) of yeast than lower (0.1%) and intermediate level (0.2%) of yeast supplementation (2.2) in broilers up to 42^{nd} days.

The present study revealed that the group supplemented with 0.2% yeast had significantly (P>0.05) better mean cumulative feed efficiency (1.80) which is higher than those (1.99) reported by Onwurah *et al.* (2014) for the birds fed with 2 g yeast/kg diet and control group (2.23).

In this study, yeast supplemented birds had significantly (P<0.05) better mean cumulative feed efficiency (1.8) than control (1.98), this result is in concurrence with previous result of Hana *et al.* (2015), who reported that feed conversion ratio (FCR) was better in 0.3% yeast fed group (1.8) than control (2.3). Furthermore, Geo *et al*. (2008), also stated that supplemental yeast culture (YC) at 2.5 g/kg improved feed conversion ratio (1.95) in broilers compared with control (2.03) at 42 days of age.

It is inferred from this study that the feed efficiency pattern matches with body weight and body weight gain with gradual increase in yeast, the cumulative feed efficiency also more efficient in all groups. Improvement in feed efficiency due to yeast feeding in this study is also in accordance with previous reports of Sherief *et al.* (2011), Chae *et al*. (2012), El- Naga (2012), Kassem and Fayed (2012), Reisinger *et al*. (2012), Kumar *et al*. (2013) and Shahir *et al.* (2014).

Contrary to our finding, Mohamed E. Ahmed *et al*. (2015) reported that poorer (P≤0.05) feed conversion ratio for birds fed the 3% dietary yeast (1.94) compared to the negative control (1.79) up to 6 weeks of age. However, Shilpa *et al.* (2007) recorded that the mean cumulative feed efficiency did not show any significant difference between yeast supplemented group and control group which could be due to high-fiber and low protein diets used for their studies.

The better mean cumulative feed efficiency observed in the group fed with 0.2% yeast might be due to early colonization of beneficial yeast might have played a vital role in the establishment of favorable microbial environment in the gut which had resulted in better utilization of feed and better absorption of nutrients. Also might be due to yeast (*Saccharomyces cerevesiae)* having stimulating action on digestive tract, as well as improvement of intestinal morphology, as evidenced by increased villi height with absorptive area for nutrients and improved nutrient digestibility (Hampson, 1986).

Livability

The mean percent cumulative livability up to 6^{th} week of experimental period showed statistically non significant (P>0.05) difference between yeast fed (0.2, 0.15 and 0.1%) groups and control group. This present finding concurred with previous report of Gao *et al*. (2008) and Reisinger *et al*. (2012). However, Onwurah *et al*. (2014) who observed that no significant (P>0.05) difference in mean percent livability between birds fed 0g, 1.0g, 1.5g and 2.0g yeast in feed as well as water. Numerically less mean per cent livability recorded in control group (93.05 ± 2.77%) than yeast treated group (95.83 ± 2.40 %) in this study is in accordance with the finding of Muthusamy *et al*. (2011) and Kassem and Fayed (2012) who found less mean per cent livability in control group (94 and 88.05 % respectively) as compared to yeast fed group (98 and 97.3%).

However, Karaoglu and Durdag (2005) found no mortality in 1g/kg probiotic (*Saccharomyces cerevisiae*) supplemented group as compared with control (1.8%) group. The possible reason for showing non significant effect of yeast on livability in this study could be due to genetic makeup of birds and better manage mental condition followed during the experiment.

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