

## EFFECT OF NON GENETIC FACTORS ON REPRODUCTION TRAITS OF GIR CROSSBRED IN ORGANIZED FARM

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**Abstract:** The data for the present investigations were collected in organized farm of the history and pedigree sheets maintained at Research Cum Development Project on Cattle, M.P.K.V., Rahuri, (MS), for the period of 40 years (1972 to 2011) on reproduction and production traits of Gir triple cross and their *Interse*.

The data were classified according to genetic group, season of birth/calving, period of birth/calving and lactation order. In order to overcome non-orthogonality of the data due to unequal subclass frequencies, least squares techniques (Harvey, 1990) was used to estimate the effect of different factors using different Effect of genetic and non-genetic factors. The results obtained in the present investigation of the overall least squares means of AFS in F<sub>1</sub>G and *Interse* of F<sub>1</sub>G were  $496.72 \pm 5.08$  and  $660.31 \pm 8.86$  days, respectively. The DMRT revealed that the POB (1975-1977) had significantly lower AFS in F<sub>1</sub>G group. Cows of AFS of cows born during *Interse* of F<sub>1</sub>G group the AFS of cow born during period 1983-1988 had significantly lower AFS followed by cows born during the period 1977-1982, 1989-1994, 2007-2011, 1995-2000 and 2001-2006. The season of birth had non-significant effect on AFS in all genetic groups. The generation had significant ( $P < 0.01$ ) effect on AFS. The overall mean AFS as affected by generation was  $645.81 \pm 5.18$  days in F<sub>1</sub>G. The effect of genetic group on AFS was non-significant. The overall least squares means of AFS in F<sub>1</sub> cows of F<sub>1</sub>G was  $538.82 \pm 7.00$  days, while in cows of *Interse* of F<sub>1</sub>G it was  $760.44 \pm 12.61$  days, respectively.

**Keywords:** Reproduction traits, genetic, non-genetic factors.

### INTRODUCTION

The economics of dairy Industry is based on productivity of the animals which is govern by several genetic and non-genetic factors. To exploit the genetic potential of the animals it is essential to know the contribution of non-genetic factors to enable them for exploitation. Comparative study is most essential to evaluate the genetic and non-genetic parameters which affect reproduction traits.

The crossbreeding programme is quickest way to bring about the improvement in economic traits of Dairy cattle. The crossing of non-descript indigenous cattle with exotic dairy breeds like Holstein, Jersey and Brown Swiss for high productivity has been the widely adopted policy in India. By crossbreeding,

hybrid vigour and additive genetic potential of highly productive exotic breeds are exploited. Thus genetic improvement of livestock by cross breeding is relatively a worldwide accepted concept for enhancing their growth, production and reproduction performance.

Although exotic cattle and their crosses are being used increasingly to raise milk production in hot climate of Indian sub-continent, it is extremely difficult to predict which breed, cross or generation will give highest economic returns over investment, because of the wide variation in performance of crossbreds due to differences of exotic donor breed and adaptability of the crossbred to the divergent climatic conditions of the tropics (Patel and Dave, 1987). Hence, identification and stabilization of the optimum

level of exotic inheritance is still moot point in the crossbreeding programme (Dalal *et al.*, 1991). It is very essential to assess the comparative performance of crossbreds of various generations under divergent agro climatic environment of formulation and implementation of long term breeding programmes (Prabhukumar *et al.*, 1990).

The improvement achieved in crossbred animals can possible be stabilized against the loss of heterosis over the generation. There is increase or decrease in the performance of crossbreds during different generation. This change in performance may be due to the effect of heterosis, segregation and recombination of genes of non-dominant effect. Thus, there is need to assess the comparative performance of these crossbred animals in different generations (Bhagat *et al.*, 2006).

## MATERIAL AND METHODS

The data were collected from the history and pedigree sheets maintained at Research Cum Development Project on Cattle, M.P.K.V., Rahuri, Dist. - Ahmednagar (MS), for the period of 40 years (1972 to 2011) on reproduction traits of Gir triple cross and their *Interse*.

The animals were kept under loose housing system with lofing area and covered sheds. All calves were housed in calf pens up to three months of age and thereafter reared separately in loose housing system according to age group. The feeding and management of the cattle was more or less uniform throughout the year. The maintenance, production and growth ration were given as per feeding standards with green and dry fodders.

The data were collected as follows

### I. Pre-partum reproduction traits (days)

1. Age at first service (AFS)
2. Age at first fertile service (AFFS)
3. Age at first calving (AFC)

### II. Post- partum reproduction traits (days)

1. Open period (OP)
2. Service period (SP)
3. Calving interval (CI)

The data were classified according to genetic group, season of birth/calving, period of birth/calving and lactation order. The following generations were considered for estimation of least square means for production and reproduction traits.

Genetic group	G <sub>1</sub>	G <sub>2</sub>	G <sub>3</sub>	G <sub>4</sub>	G <sub>5</sub>	G <sub>6</sub>	G <sub>7</sub>
50 % HF +25 % J+ 25 % Gir	FJG	H	3H	4H	5H	6H	7H

As per climatic conditions of the farm the data of each year were divided into three seasons as Rainy, Winter and Summer. The data were divided into different genetic groups according to their period of birth. The parity wise data were collected up to 7<sup>th</sup> lactation of animal maintained at the farm. In order to overcome non- orthogonality of the data due to unequal subclass frequencies, least squares techniques (Harvey, 1990) was used to estimate the effect of different factors using different models at Department of Statistic, National Dairy Research Institute, (NDRI) Karnal, India.

Effect of genetic and non-genetic factors were estimated by least squares technique suggested by Harvey (1990) using the following model:

### (a) Model for estimation of effect of non-genetic factors

$$Y_{ijkl} = \mu + A_i + B_j + C_k + e_{ijkl}$$

Where,

$Y_{ijkl}$  = Performance record of  $i^{\text{th}}$  period of birth/calving of  $j^{\text{th}}$  season of birth/calving and  $k^{\text{th}}$  lactation order

$\mu$  = Overall mean

$A_i$  = Effect of  $i^{\text{th}}$  period of birth/calving

$B_j$  = Effect of  $j^{\text{th}}$  season of birth/calving

$C_k$  = Effect of  $k^{\text{th}}$  lactation order

$e_{ijkl}$  = Random error NID (0, 62e)

The period of birth effect was estimated only for the age at first calving.

### Duncan's Multiple Range Test (DMRT)

Duncan's multiple range test as modified by Kramer (1957) was used to make pair wise

comparison among the least squares means with the use of inverse elements and root mean squares of error.

If the values

$$(Y_i - Y_j) \times \sqrt{\frac{2}{C_{ii} + C_{jj} - 2C_{ij} > s^2 e, Z(P, ne)}}$$

$Y_i - Y_j$  = Difference between the two least square means

$C_{ii}$  = Corresponding  $i^{\text{th}}$  diagonal elements of C matrix

$C_{jj}$  = Corresponding  $j^{\text{th}}$  diagonal elements of C matrix

$Z(P, ne)$  = Standardized range value in Duncan's table at the chosen level of probability for  $ne$  the error degrees of freedom

$P$  = Number of means involved in the comparison

$\sigma^2 e$  = Root mean squares of error.

### Correction of data

The data on reproduction and production traits were corrected for the significant effects of period and season of birth/calving according to the formula suggested by Gacula *et al.* (1968). The corrected data were used to estimate the effect of genetic group and generation, similarly to estimate genetic parameters *viz.*, genetic correlations, phenotypic correlations and heritability.

### (b) Model for effect of genetic group and generation

$$Y_{ijk} = \mu + A_i + B_j + e_{ijk}$$

Where,

$Y_{ijk}$  = Performance record of  $i^{\text{th}}$  genetic group of  $j^{\text{th}}$  generation

$\mu$  = Overall mean

$A_i$  = Effect of  $i^{\text{th}}$  genetic group

$B_j$  = Effect of  $j^{\text{th}}$  generation

$e_{ijk}$  = error NID (0,  $\sigma^2 e$ )

## RESULTS AND DISCUSSION

The data pertaining to FJG (362 records), and *Interse* of FJG (1082 records), from year 1972 to

2011 (40 years) are used for analysis. The overall least squares mean of AFC in FJG were  $496.72 \pm 5.08$  days while in *Interse* of FJG were  $660.31 \pm 8.86$  days, respectively. Similar results have been reported by Gill *et al.* (1978) in crossbred of Red Danish x Sahiwal cows and Navale (1991) in Brown Swiss crosses, respectively. The season of birth had non-significant effect on AFS in all genetic groups. Similar result was reported by Ahuja *et al.* (1961) in Hariana cattle, Luktuke *et al.* (1961) in Gir cow, Ranjan *et al.* (1981) in HF, J and Gir crosses.

The generation had significant ( $P < 0.01$ ) effect on AFS. There were significant differences in the generation of FJG group. The overall mean AFS as affected by generation was  $645.81 \pm 5.18$  days in FJG. Significantly lowest AFS (days) was observed in the I<sup>st</sup> generation cows, however, the highest AFS noticed in cows of VI<sup>th</sup> generation. The cows from generation III<sup>rd</sup> to V<sup>th</sup> and VII<sup>th</sup> were performance at par with each other in FJG group. The overall least squares mean of AFS in FJG was  $538.82 \pm 0.37$  days, while in *Interse* of FJG was  $760.44 \pm 12.61$  days, respectively. The effect of generation was significant in FJG group. The genetic group wise overall mean AFS was  $739.97 \pm 7.29$  days.

The overall least square means of AFC in FJG were  $816.86 \pm 8.02$  days, while in *Interse* of FJG was  $1038.30 \pm 13.38$  days, respectively.

Significant effect of generation on AFC in all genetic group of Gir crossbred cow. The overall mean for generation of AFC was  $1017.17 \pm 7.90$  days in FJG group. The overall least squares mean of OP in FJG was  $66.61 \pm 3.33$  days. However in *Interse* of FJG was  $79.07 \pm 2.31$  days. The highest AFC days than the present results were reported by Thombre *et al.* (2002) in HF x D halfbreds ( $1308.75 \pm 76.44$ ), Bhagat *et al.* (2006) in Phule Triveni ( $818.85 + 7.80$ ), IFG ( $1040.03 + 10.47$ ) and *Interse* of Phule Triveni were ( $1006.10 + 16.09$ ).

The period of calving and season of calving had non-significant effect on service period. Similar results were also reported by Kamble (2003) in Gir crossbreds. Lactation order had non-significant effect on service period in all genetic groups. The effect of generation and genetic group was non-significant on service

**Table 1: Least squares means for AFS (days) in FJG group**

Sources of variation	Genetic groups			Sources of variation	Genetic groups		
	Interse of FG				Interse of FJG		
	N	Mean	S.E.		N	Mean	S.E.
$\mu$	115	496.72	5.08	$\mu$	364	660.31	8.86
POB							
1975-1977	69	482.21 <sup>a</sup>	6.65	1977-1982	93	596.11 <sup>b</sup>	10.10
1978-1980	46	511.24 <sup>b</sup>	7.94	1983-1988	108	532.92 <sup>a</sup>	9.40
				1989-1994	109	611.47 <sup>c</sup>	9.31
				1995-2000	37	775.39 <sup>d</sup>	15.99
				2001-2006	10	827.97 <sup>d</sup>	30.76
				2007-2011	7	617.98 <sup>b</sup>	36.74
SOB							
S <sub>1</sub> (Jun-Sept)	32	490.99	9.41	S <sub>1</sub> (Jun-Sept)	106	652.35	11.79
S <sub>2</sub> (Oct-Jan)	44	499.14	8.52	S <sub>2</sub> (Oct-Jan)	141	672.17	11.21
S <sub>3</sub> (Feb-May)	39	500.03	8.52	S <sub>3</sub> (Feb-May)	117	656.40	11.37

**Table 2: Generation wise least squares means for AFS (days) in Gir crossbred cow**

Sources of variation	Genetic groups		
	FJG		
	N	Mean	S.E.
$\mu$	486	645.81	5.18
Generation			
G <sub>1</sub>	122	500.23 <sup>a</sup>	7.91
G <sub>2</sub>	119	658.16 <sup>c</sup>	8.01
G <sub>3</sub>	94	663.34 <sup>cd</sup>	9.02
G <sub>4</sub>	68	639.72 <sup>b</sup>	10.61
G <sub>5</sub>	46	671.78 <sup>d</sup>	12.89
G <sub>6</sub>	17	711.41 <sup>e</sup>	21.21
G <sub>7</sub>	20	676.55 <sup>d</sup>	19.53

Means in the same column with different superscript differed significantly

**Table 3: Least squares means for AFFS (days) in FJG group**

Source of variation	Genetic groups			Source of variation	Genetic groups		
	Interse of FG				Interse of FJG		
	N	Mean	S. E.		N	Mean	S. E.
$\mu$	<b>115</b>	<b>538.82</b>	<b>7.00</b>	$\mu$	<b>364</b>	<b>760.44</b>	<b>12.61</b>
POB				POB			
1975-77	69	503.88	9.16	1977-1982	93	654.89 <sup>b</sup>	14.38
1978-80	46	571.75	10.94	1983-1988	108	604.01 <sup>a</sup>	13.38
				1989-1994	109	691.26 <sup>c</sup>	13.27
				1995-2000	37	865.43 <sup>e</sup>	22.77
				2001-2006	10	956.00 <sup>f</sup>	43.08
				2007-2011	7	791.06 <sup>d</sup>	52.32
SOB				SOB			
S <sub>1</sub> (Jun-Sept)	32	526.00	12.97	S <sub>1</sub> (Jun-Sept)	106	752.37	16.79
S <sub>2</sub> (Oct-Jan)	44	545.44	11.74	S <sub>2</sub> (Oct-Jan)	141	882.95	15.96
S <sub>3</sub> (Feb-May)	39	545.02	11.74	S <sub>3</sub> (Feb-May)	117	746.00	16.19

Means under each class in the same column with different superscript differed significantly

**Table 5. Generation wise least squares means for AFFS (days) in Gir crossbred cow**

Sources of variation	Genetic groups		
	FJG		
	N	Mean	S.E.
$\mu$	486	739.97	7.39
Generation			
G <sub>1</sub>	122	541.53 <sup>a</sup>	11.28
G <sub>2</sub>	119	743.68 <sup>b</sup>	11.42
G <sub>3</sub>	94	769.40 <sup>cd</sup>	12.85
G <sub>4</sub>	68	754.60 <sup>c</sup>	15.11
G <sub>5</sub>	46	778.71 <sup>d</sup>	18.37
G <sub>6</sub>	17	798.24 <sup>e</sup>	30.22
G <sub>7</sub>	20	793.65 <sup>e</sup>	27.86

Means in the same column with different superscript differed significantly

**Table 6: Least squares means for AFC (days) in FJG and Interse of FJG group**

Sources of variation	Genetic groups			Sources of variation	Genetic groups		
	Interse of FG				Interse of FJG		
	N	Mean	S.E.		N	Mean	S.E.
$\mu$	115	816.86	8.02	$\mu$	364	1038.30	13.38
POB				POB			
1975-77	69	781.99 <sup>a</sup>	10.49	1977-1982	93	939.94 <sup>b</sup>	15.25
1978-80	46	851.72 <sup>b</sup>	12.53	1983-1988	108	876.96 <sup>a</sup>	14.19
				1989-1994	109	979.02 <sup>c</sup>	14.07
				1995-2000	37	1140.13 <sup>e</sup>	24.15
				2001-2006	10	1224.09 <sup>f</sup>	46.45
				2007-2011	7	1069.68 <sup>d</sup>	55.49
SOB				SOB			
S <sub>1</sub> (Jun-Sept)	32	803.60	14.85	S <sub>1</sub> (Jun-Sept)	106	1040.10	17.81
S <sub>2</sub> (Oct-Jan)	44	825.06	13.45	S <sub>2</sub> (Oct-Jan)	141	1055.29	16.93
S <sub>3</sub> (Feb-May)	39	821.91	13.45	S <sub>3</sub> (Feb-May)	117	1019.52	17.17

Means under each class in the same column with different superscript differed significantly

**Table 9: Generation wise least squares means for AFC (days) in Gir crossbred cow**

Sources of variation	Genetic groups		
	FJG		
	N	Mean	S.E.
$\mu$	486	1017.17	7.90
Generation			
G <sub>1</sub>	122	820.03 <sup>a</sup>	12.06
G <sub>2</sub>	119	1021.59 <sup>b</sup>	12.21
G <sub>3</sub>	94	1044.24 <sup>c</sup>	13.74
G <sub>4</sub>	68	1030.53 <sup>b</sup>	16.15
G <sub>5</sub>	46	1060.45 <sup>d</sup>	19.64
G <sub>6</sub>	17	1075.99 <sup>d</sup>	32.31
G <sub>7</sub>	20	1067.35 <sup>d</sup>	29.79

Means in the same column with different superscript differed significantly

**Table 10: Least squares means for open period (days) in FJG group**

Source of variation	Genetic groups			Source of variation	Genetic groups		
	Interse of FG				Interse of FJG		
	N	Mean	S. E.		N	Mean	S. E.
$\mu$	282	66.61	3.33	$\mu$	771	74.74	5.13
POC				POC			
1977-1982	219	74.45	5.27	1979-1984	188	73.14 <sup>b</sup>	5.53
1983-1988	63	58.77	5.23	1985-1990	218	65.91 <sup>a</sup>	3.93
				1991-1996	217	84.55 <sup>c</sup>	4.38
				1997-2002	124	75.82 <sup>b</sup>	4.94
				2003-2007	19	97.67 <sup>d</sup>	11.05
				2008-2011	5	51.35 <sup>a</sup>	20.91
<b>SOC</b>				<b>SOC</b>			
S <sub>1</sub> (Jun-Sept)	96	69.69	4.55	S <sub>1</sub> (Jun-Sep)	231	73.20	5.72
S <sub>2</sub> (Oct-Jan)	90	60.45	4.89	S <sub>2</sub> (Oct-Jan)	310	75.26	5.50
S <sub>3</sub> (Feb-May)	96	69.68	4.77	S <sub>3</sub> (Feb-May)	230	75.76	5.72
<b>LO</b>				<b>LO</b>			
L <sub>1</sub>	119	76.52	5.41	L <sub>1</sub>	312	82.59	4.38
L <sub>2</sub>	55	68.41	6.31	L <sub>2</sub>	183	74.01	5.12
L <sub>3</sub>	43	71.32	6.51	L <sub>3</sub>	130	71.20	5.45
L <sub>4</sub>	28	72.26	7.53	L <sub>4</sub>	86	78.45	6.33
L <sub>5</sub>	18	55.56	9.63	L <sub>5</sub>	39	66.59	8.37
L <sub>6</sub>	10	71.48	12.44	L <sub>6</sub>	14	66.58	12.93
L <sub>7</sub>	9	50.70	13.85	L <sub>7</sub>	7	83.74	17.83

Means under each class in the same column with different superscript differed significantly

**Table 11: Generation wise least squares means for open period (days) in Gir crossbred cow**

Source of variation	Genetic groups		
	FJG		
	N	Mean	S.E.
$\mu$	1053	79.07	2.30
Generation			
G <sub>1</sub>	282	75.85	2.64
G <sub>2</sub>	293	79.80	2.59
G <sub>3</sub>	216	69.64	3.01
G <sub>4</sub>	117	84.23	4.09
G <sub>5</sub>	106	74.97	4.30
G <sub>6</sub>	20	93.10	9.91
G <sub>7</sub>	19	75.89	10.16

**Table 12: Least squares means for service period (days) in FJG and Interse of FJG group**

Sources of variation	Genetic groups			Sources of variation	Genetic groups		
	Interse of FG				Interse of FJG		
	N	Mean	S.E.		N	Mean	S.E.
$\mu$	282	133.85	7.01	$\mu$	782	150.11	8.83
POC				POC			
1977-1982	219	136.03	11.08	1979-1984	118	141.75	10.55
1983-1988	63	131.68	10.99	1985-1990	289	134.65	7.48
				1991-1996	217	149.93	8.35
				1997-2002	130	145.70	9.26
				2003-2007	20	193.23	20.63
				2008=2011	8	135.41	31.81

SOC				SOC			
S <sub>1</sub> (Jun-Sept)	96	128.38	9.56	S <sub>1</sub> (Jun-Sep)	237	146.13	9.93
S <sub>2</sub> (Oct-Jan)	90	139.47	10.28	S <sub>2</sub> (Oct-Jan)	313	151.98	9.70
S <sub>3</sub> (Feb-May)	96	133.71	10.03	S <sub>3</sub> (Feb-May)	232	152.22	10.12
LO				LO			
L <sub>1</sub>	119	145.02	11.36	L <sub>1</sub>	313	165.82	7.52
L <sub>2</sub>	55	140.34	13.26	L <sub>2</sub>	190	157.23	8.58
L <sub>3</sub>	42	136.80	13.69	L <sub>3</sub>	131	154.14	9.52
L <sub>4</sub>	28	120.65	15.82	L <sub>4</sub>	86	157.44	11.39
L <sub>5</sub>	18	117.99	20.24	L <sub>5</sub>	40	146.27	15.31
L <sub>6</sub>	11	136.32	26.19	L <sub>6</sub>	15	138.22	23.64
L <sub>7</sub>	9	139.85	29.12	L <sub>7</sub>	7	131.66	33.88

Table 14: Least squares means for calving interval (days) in FJG and *Interse* of FJG group

Sources of variation	Genetic groups			Sources of variation	Genetic groups		
	<i>Interse</i> of FG				<i>Interse</i> of FJG		
	N	Mean	S.E.		N	Mean	S.E.
$\mu$	285	410.02	7.53	$\mu$	776	427.42	8.77
POC				POC			
1977-1982	222	409.78	11.66	1979-1984	104	420.13	10.92
1983-1988	63	410.26	11.89	1985-1990	288	415.52	7.38
				1991-1996	220	423.31	8.26
				1997-2002	136	425.43	9.07
				2003-2007	20	473.39	20.58
				2008-2011	8	406.75	31.78
SOC				SOC			
S <sub>1</sub> (Jun-Sep)	93	405.26	10.47	S <sub>1</sub> (Jun-Sep)	233	426.39	9.89
S <sub>2</sub> (Oct-Jan)	94	409.79	10.98	S <sub>2</sub> (Oct-Jan)	313	428.56	9.67
S <sub>3</sub> (Feb-May)	98	415.02	10.73	S <sub>3</sub> (Feb-May)	230	427.31	10.06
LO				LO			
L <sub>1</sub>	117	426.31	12.23	L <sub>1</sub>	303	441.36	7.54
L <sub>2</sub>	57	419.32	14.15	L <sub>2</sub>	194	437.18	8.54
L <sub>3</sub>	42	416.20	14.81	L <sub>3</sub>	129	431.25	9.57
L <sub>4</sub>	30	397.68	16.57	L <sub>4</sub>	86	435.01	11.41
L <sub>5</sub>	19	393.92	21.23	L <sub>5</sub>	40	426.39	15.31
L <sub>6</sub>	11	397.12	28.34	L <sub>6</sub>	17	408.65	22.31
L <sub>7</sub>	9	419.39	31.53	L <sub>7</sub>	7	412.13	33.87

period in all genetic groups. The overall least squares mean of calving interval in FJG was  $410.02 \pm 7.53$  days, However in *Interse* of FJG it was  $427.42 \pm 8.77$  days. The present results resembled with Bhoite (1996) in FJG ( $135.08 \pm 9.20$  days) and *Interse* of FJG ( $145.02 \pm 7.26$  days) genetic groups and Kamble (2003) in FJG ( $139.00 \pm 3.40$  days) groups. Analysis of variance revealed that period of calving and season of calving had non-significant on calving interval in Gir crossbred cows. Lactation order had non-significant effect on calving interval in all genetic groups. Effect of generation had significant

( $P < 0.05$ ) effect in FJG group. In FJG group the significantly lowest CI was noticed in cows of I<sup>st</sup> generation and significantly highest CI had been noticed in VI<sup>th</sup> generation. The cows of II<sup>nd</sup> and III<sup>rd</sup> generation performance was at par, similarly, the cows of IV<sup>th</sup> and V<sup>th</sup> generation performance was at par with each other. The effect of genetic group was non-significant on calving interval in all genetic groups. The results were in consonance with Bhoite and Kale (1996) in triple crosses, Kanawade (1997) and Bhagat et al. (2006) in Gir crossbred cows and Jadhav (2011) in Gir crossbred.

## CONCLUSION

1. Most of the reproduction traits under study were affected by non-genetic factors indicating the importance of feeding and management for enhancing performance.
2. The first generation of F<sub>1</sub>G showed significantly higher performance over their *Interse* because of hybrid vigor, subsequent decline in further generations in F<sub>1</sub>G indicated to restrict the *Interse* mating.

## References

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