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USING WET FEED IN FEEDING JAPANESE QUAIL UNDER SUMMER CONDITIONS

M.F.A. Farghly[1], Ali E. Galal[1] and Enas A. M. Ahmad [2]

[1]Dept. of Poult.Prod., Fac. Agric., Assiut Uni., Assiut, Egypt.

[2]Anim. and Poult. Prod. Dep., Fac. of Agric. and Nat. Res., Aswan Uni., Egypt.

Corresponding Author: M.F.A. Farghly[1]Email**:** farghly20002000@yahoo.com

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ABSTRACT: Many strategies to avoid the harmful effects of ambient high temperature can be applied on specific feed manipulations as wet feed. The present study was conducted to investigate the impact of using wet feed in hottest different times of day to alleviate the negative effects of heat stress during summer season in Upper Egypt. Hundred and twenty Japanese quail chicks (one-day old) were reared in batteries and assigned to four groups (30 birds /each). The chicks of first group (C) were full-fed *ad libitum* fed dry mash feed. While, the first, second and third treatment (T1, T2 and T3) was fed on wet feed (1 part of feed to 1 part of water) for different periods during the noon (the highest recorded temperature hours during the day): 1000-1300h, 1300-1600h and 1000-1600h, respectively. All experimental chicks were raised under similar environmental and managerial conditions. The results showed that the third and fourth groups (T2; 1300-1600h or T3; 1000-1600h) had superior body weight, feed conversation, dressed carcass and mortality percentages compared to the other groups (control group, C and second group, T1). Otherwise, insignificant differences observed in feed consumption, plumage conditions and some blood parameters. It could be concluded that birds fed wet feed during all hottest period of day (1000-1600h) may help to decrease peaks of heat production, enhance evaporative activity and reduces heat load, resulting in positive effects on growth performance and health status of the birds reared in hot climate. Consequently, it could be recommended to present the feed for growing Japanese quail as wet form at hottest time of day under summer conditions.

Key Words: Performance - wet feed - hot summer -Japanese quail.

INTRODUCTION

In Upper Egypt, the hot summer generates a status of heat stress and evokes a combination of physiological, behavior changes and poor performance of poultry, which is mainly as a result of reduced feed consumption and efficiency of feed utilization (Farghly, 2012; Farghly, *et al.,* 2017; 2018ab). Bird heat production is influenced by many factors including feed timing, quality and form as wet feed (Farghly, 2010, 2011and Afsharmanesh *et al.,* 2016). Wet feed had the potential to improve growth and economic efficiency of bird in hot climate (Christopher *et al.,* 2006; Forbes *et al.,* 2007; Awojobi *et al.,* 2011; Farghly 2012 and Farghly, *et al.,* 2018d).

Use of wet feed can enhance body weight gain and feed conversion ratio of birds (Afsharmanesh *et al.,* 2006). Improved performance in wet feeding is attributed to a decrease in feed wastage, energy spent for eating, increased digestibility and improved palatability (Mortazavi and Afsharmanesh 2017 and Farghly *et al.,* 2018d). The addition of water to dry feed mash before birds feeding stimulate greater intake by enhancing the feed flavor and the hydrated diet would become soluble in the gut, thereby facilitating faster digestion (Bailey 1999; Scott 2002; Farghly and Abou-Kassem 2014). These effects may be due to the changes in the physical parameters or feed forms and to allowing more fast penetration of digestive juices (Awojobi *et al.,* 2009, 2011; Farghly *et al.,* 2014).

Many feeding systems have been used to avoid the harmful effects of heat stress on poultry production. Feed manipulations (particle size, moisture content), feed timing of restriction and choice feeding management have all proven to be suitable to poultry under ambient high temperature (Diarra and Tabuaciri 2014; Farghly 2018; Farghly and Mahmoud 2018; Farghly, *et al.,* 2018abcde). Therefore, the main aim of this experiment is the management of wet feeding applied to avoid some of the adverse effects of heat stress on Japanese quail performance.

MATERIALS AND METHODS

This work carried out at Department of Poultry Production (research poultry farm), Agriculture Faculty, Assiut University, Egypt. A total number of 120 chicks of Japanese quail (one-day old) were used to study the effect of wet feeding (1 part of feed to 1 part of water) on the growth performance of birds under summer conditions. All experimental birds were raised in batteries under similar environmental and managerial conditions. All chicks were reared in batteries and assigned to 4 groups (30 birds /each). The chicks of first group (C) were full-fed *ad libitum* fed dry mash feed. While, the first, second and third treatment (T1, T2 and T3) was fed on wet feed (1 part of feed to 1 part of water) for different periods during the noon (the highest recorded temperature hours during the day): 1000-1300h, 1300-1600h and 1000-1600h, respectively. The means of indoor temperature and humidity were recorded during experiment period (Table, 1).

All experimented chicks were weighed individually biweekly from 0 to 6 weeks of age. All experimental chicks were fed a starter diet (24% crude protein and 2600 Kcal/kg of diet) from 0 to 6 weeks of age. The hatched chicks were subjected to continuous light program for 24 hrs per day during the first week of age. Thereafter, the photoperiod was adjusted to 12 hrs lighting regimens with light intensity of 10 Lux. Body weight gain (BWG) was estimated for the experimental period of growing (0 to 6 weeks) depending on the difference between the initial and final body weight then divided by number of days during this period. Feed conversion ratio (FCR, g feed/ g gain) was estimated for the all growing period dividing the recorded feed consumption (g) by the recorded body weight gain (g/d) of birds. The following carcass parameters (dressing percentage, liver, heart and gizzard) were recorded. The body feathering area was using a scale from 1(completely feathered) to 5 (featherless). Body temperatures (BT, ºC) were measured by using a thermometer inserted into the rectum for 2 minutes at depth of 2 cm in midday. Leg problems and dead birds were recorded daily and expressed as percentages during the experimented period.

The blood samples were centrifuged at 3000 rpm for 15 min and the plasma obtained was stored at -20 ◦C until analysis. The total protein (TP), albumin (A), globulin (G), glucose and cholesterol levels of the plasma, as well as the transaminase enzymes activities (aspartate transferase, AST and alanine transferase, ALT), total antioxidant capacity (T-AOC) and malondialdehyde (MDA) level were determined colorimetrically using diagnostic kits from Spectrum (Cairo, Egypt).

Statistical analysis: The collected data were subjected to ANOVA by applying the General Linear Model (GLM) Procedure of SAS software (SAS Institute, 2009). Duncan (1955) was used to detect differences among means of different groups. Before analysis, all percentages were subjected to arcsine transformation to approximate normal distribution.

RESULTS AND DISCUSSIONS

1- Body weight (BW) and gain (BWG): Body weight and body weight gain affected by wet feed presented in Table (2), it demonstrated significant differences ($P \leq 0.05$) in body weight and body weight gain for all groups at all studied ages except at 0 and 2 weeks of age for BW parameter as well as at 0-2 weeks of age for BWG parameter. The BW and BWG of third and fourth groups (T2 and T3) were significantly ($P \leq 0.05$) increased than those of control group (C) at 4 weeks of age, while the BW of second group (T1) had an intermediate value. The BW of T3 group was significantly exceeded those of C and T1 groups at 6 weeks of age. While, the BW of third group (T2) had an intermediate values. At 4-6 weeks of age, the BWG of fourth group (T3) was significantly ($P \leq 0.05$) exceeded those of first and third groups (C and T2). While, the BW of second group (T1) had an intermediate values. The mean of BWG for fourth group (T3) significantly exceeded those of first and second groups (C and T1). Enormity of the reduction in growth performance at ambient high temperature (30°C), while appears to be associated with high growth performance at thermoneutral zone (25°C) (Deeb and Cahaner 2001). Heat load can be decreased by improving the dissipation of heat production by managing the thermal production pattern. Using wet feed vs dry feed may be suitable for birds during summer (Beg, *et al.*, 2011; Farghly, 2012).

Wet feed may contribute to enhance the growth performance by decreased digesta viscosity, previously associated with a reduction in the anti-nutritional effects of non-starch polysaccharides (Philip *et al.*, 1995). Also, it may be due to allow more fast penetration of digestive juices by these changes in physical parameters of the feed form (Frikha, *et al.*, 2009). The results of this experiment were supported by Yalda and Forbes, (1995), Ogbonna *et al.*, (2001), Awojobi and Meshioye (2001), Awojobi *et al.,* (2009 and 2011) and Dei and Bumbie, (2011) who reported that wet feed was more beneficial and improved growth rate than mash or dry feed. Akinola *et al.,* (2015) found a significant higher BWG for chickens fed wet feed. Farghly *et al.*, (2018d) reported that wet feeding improved the growth rate as body weight and gain of Muscovy ducklings. They reported that BW of of Muscovy ducklings fed wet feed was 1.97 and 3.12% higher than that of birds fed dry mash feed and the BWG of the birds fed wet feed was 6.91 and 10.72% higher than that of the birds fed dry mash feed. Similar observations have been reported in growing quails and broilers (Scott and Silversides, 2003; Afsharmanesh *et al.*, 2006; Syafwan *et al.*, 2011; Farghly, 2012; Farghly *et al.,* 2014; Afsharmanesh *et al.*, 2016; Mortazavi and Afsharmanesh 2017). However, Beg, *et al.*, (2011) reported no difference in bird body weight and gain.

2- Feed consumption (FC) and feed conversion (FCR):

No significant differences in feed consumption (FC) values in the experimented four treatments group at all ages studied (Table 3). However, the differences in average FCR during the experimental periods from 4-6 weeks of age were significant (P≤0.05). The average FCR of first and fourth groups (C and T3) significantly (P≤0.05) improved than those of second group (T1), during the interval 4-6 weeks of age. At the overall mean of FCR, birds of third group (T3) had significant (P≤0.05) better FCR values than those of second group (T1). While, the FCR of first and third groups (C and T2) had an intermediate values. Wet feed had been found to stimulate improved feed conversion efficiency (Awojobi and Meshioye, 2001; Awojobi *et al.,* 2009; Farghly 2012).

In the hot climate, Dei and Bumbie, (2011) found that reducing the heat stress and then enhance feed consumption improve the growth performance. Scott (2002) and Afsharmanesh *et al.,* (2010) found that the offered hydrated feed allowed decreasing the rates of passage of feed enhanced markedly nutrients retention. Als, Yasoar and Forbes, (2000) found that feeding in wet feed form lowed (digesta viscosity with crypt cell proliferation) and increased intestinal villus height, consequently digestion to start immediately, and may enhance the digestibility of nutrient. Afsharmanesh *et al.,* (2016) and Mortazavi and Afsharmanesh (2017) reported that wet feeding significantly improved feed conversion ratio in compared with mash group.

The results of the improvement for feed conversion by using wet feed are in the same line with Jahan *et al.* (2006), Salari *et al.* (2006), Awojobi *et al.* (2009), Mirghelenj and Golian (2009), Yaghoubfar *et al.* (2009), Jafarnejad *et al.* (2010), Awojobi *et al.* (2011), Beg, *et al.* (2011), Dei and Bumbie, (2011), Farghly and Makled (2015) and Farghly *et al.* (2018d). On the contrary of our results, Agah and Norollahi (2008) found that feed form did not affect feed conversion. Also, Yalda and Forbes, (1995) and Yasar and Forbes (2000) found that wet feed increased feed intake.

3. Carcass traits:

Effect of wet feed on carcass traits were presented in Table 4. Insignificant differences (P>0.05) in the percentages of liver, heart, gizzard and giblets percentages were found among all groups except dressed carcass percentages. The dressed carcass of third and fourth groups (T2 and T3) significantly (P≤0.05) exceeded those of second group (T1). While, the dressed carcass of first group (C) had an intermediate values. Lu *et al.* (2007), Dai *et al.* (2012) and Imik *et al.* (2012) found that ambient high temperature is related with reduction in chemical composition of meat and quality of broiler chickens. Also in broilers, Zhang, *et al.*, (2012) reported that heat stress as chronic case reduced the percentage of breast muscle. Afsharmanesh *et al.*, (2016) found that broilers fed wet feed had superior carcass percentage compared with birds fed dry feed. Farghly *et al.*, (2018d) found that wet feed affected the dressed carcass and gizzard percentages.

The obtained results are in partial agreement with foundlings of Ocak and Erener, (2005), Beg *et al.*, (2011), Farghly and Makled (2015) and Farghly *et al.*, (2018d) who, reported that wet feeding or other regimen had significant impact (P≤0.05) on carcass characteristics of broilers and Japanese quail in summer season. Farghly (2012) found that insignificant differences (P>0.05) in percentages of heart, liver and gizzard percentages were observed among all groups except dressed carcass percentages as affected by feed manipulations during summer season. On contrary, Mortazavi and Afsharmanesh (2017) showed that meat quality items were not affected by wet feeding.

4. Blood constitutes:

Blood traits affected by wet feed were presented in Table 5. Significant differences (P≤0.05) in glucose, corticosterone and T-AOC were observed among all treatments groups. However, no significant differences (P>0.05) were existed in all other blood parameters. Many studies found that blood metabolite levels consistently affected by heat stress (Star *et al.*, 2008; Mack *et al.*, 2013). Previous studies showed an immune suppressing effect of ambient high temperature (Niu, *et al.*, 2009 and Felver-Gant *et al.* 2012). Afsharmanesh *et al.*, (2016) reported that broiler chicks fed wet feed form had significant high levels of total cholesterol.

Farghly and Makled (2015) and Farghly *et al.*, (2018d) observed insignificant (P>0.05) differences were existed for studied plasma blood parameters (T protein, globulin, albumin, glucose, cholesterol, aspartate transferase, AST and alanine transferase, ALT concentrations), malondialdehyde (MDA)) and total antioxidant capacity (T-AOC) between the wet feed fed broilers and Muscovy ducklings.

5- Physiological and healthy traits: Physiological and healthy traits affected by wet feed were showed in Table (6), it present no significant differences (P≤0.05) in plumage conditions, body temperatures and leg problems among the studied four treatments groups at all ages. Significant differences (P≤0.05) were observed in H / L ratios among experimented four groups. However, no significant differences (P>0.05) were existed in lymphocyte and heterophil percentages. In same table, the mortality rates of the four experimented groups were 3.33, 0.00, 1.67 and 0.00% for all the experimental period. High temperature is enough to change circulating leucocyte component and increased in H/L ratios (Altan *et al.,* 2000). Yalçin *et al.,* (2003) found that early heat stress reduced H/L ratios of broilers. In contrast, Awojobi *et al.,* (2011) reported that heamatological indices did not show any significant difference with the application of wet feed. However, oesinophil and monocytes were significantly affected. Aengwanich (2008) found that heat stress reduced numbers of lymphocytes.

Birds can regulate or adjust their body temperatures in a narrow range of ambient temperatures from 16 to 26 °C (Diarra and Tabuaciri 2014). wet Feed may increase water intake, resulting in more water for panting evaporation. High temperature is enough to cause increased body temperature (Altan *et al.,* 2000; Farghly 2018). Ayhan *et al.,* (2000) observed that feed form significantly affect body temperatures. However, Awojobi *et al.,* (2011) found that insignificant differences were observed among feed forms. Farghly and Makled (2015) and Farghly *et al.,* (2018d) reported that wet feed and manipulations insignificantly (P>0.05) affected body temperature.

These results are in agreement with Wahlstrom *et al.,* (2001) demonsterated that feed form had little effect on plumage conditions. In contrast, Aerni, *et al.,* (2000) found that feather pecking has been shown to be more common when birds were fed pellets. Farghly and Makled (2015) and Farghly *et al.,* (2018d) found that wet feeding practices insignificantly (P>0.05) affected conformations, foot pad burns, plumage conditions and leg problems.

From achieved results, the value mortality rate was 0.0 % in birds fed wet feed than those fed dry feed, which is in the same line with Yaghoubfar *et al.*, (2009). However, Jahan *et al.*, (2006) and Beg *et al.,* (2011) found insignificant differences in mortality for feed form. Exposing birds to high temperature during midnight (more than three hours/day for 8 weeks during the summer) increased the mortality rate (Lin *et al.*, 2006). Farghly and Makled (2015) and Farghly *et al.,* (2018d) reported that wet feeding or feed practices insignificantly affected mortality rate.

CONCLUSIONS

Additional promising strategy may be use to avoid the harmful effects of heat stress involve offering a wet feeds in different times (1000-1600h). Wet feed may increase water consumption, resulting in more water for panting evaporation. These feeding practices may allow decreasing the heat load, resulting in improving the production and health status. Consequently, it could be recommended to present the feed for growing Japanese quail as wet form at hottest time of day under summer conditions.

Table (1): Means of indoor temperature and humidity values of Japanese quail house.

Intervals (month)	Temperature (C°)			Humidity (%)			THI		
	Max.	Min	Av.	Max.	Min.	Av.	Max.	Min.	Av.
Jun	33.88	24.93	29.41	58.10	44.56	51.33	31.35	23.12	27.14
Jul	35.12	26.11	30.62	61.36	45.72	53.54	32.64	24.14	28.28
Aug	35.92	27.54	31.73	60.22	45.38	52.80	33.27	25.32	29.19
Overall mean	34.97	26.19	30.58	59.89	45.22	52.56	32.42	24.19	28.20

Max = Maximum Min= Minimum Av. = Average THI=Temperature humidity index

Table (2): Effect of wet feeding on body weight and body weight gain.

Traits	Age (wks)	Treatments				SEM	P value
		C	T1	T2	T3		
Body weight (g)	0	8.06	7.91	8.14	7.89	0.65	0.4365
	2	59.33	57.80	51.24	52.91	5.66	0.8675
	4	140.35 [b]	156.38 [ab]	158.91 [a]	160.22 [a]	6.23	0.0352
	6	194.38 [b]	198.12 [b]	210.02[ab]	218.86 [a]	7.62	0.0434
Body weight gain (g/bird/day)	0 – 2	3.66	3.56	3.08	3.22	0.356	0.6256
	2 – 4	5.79 [b]	7.04 [ab]	7.69 [a]	7.67 [a]	0.421	0.0465
	4 – 6	3.86 [ab]	2.98 [b]	3.65 [ab]	4.19 [a]	0.344	0.0235
	Mean	4.44 [b]	4.53 [b]	4.81 [ab]	5.02 [a]	0.235	0.0252

[a---b] Means within row followed by different superscripts are significantly different (P≤0.05).

Table (3): Effect of wet feeding on feed consumption and feed conversion.

Traits	Age (wks)	Treatments				SEM	P value
		C	T1	T2	T3		
Feed consumption (g/bird/day)	0 – 2	8.11	8.22	8.02	7.89	0.523	0.8262
	2 – 4	13.92	14.11	13.65	13.74	0.695	0.4923
	4 – 6	16.88	17.67	17.31	17.45	1.032	0.6351
	Mean	12.97	13.33	12.99	13.03	0.651	0.6327
Feed conversion ratio (g feed/g gain)	0 – 2	2.21	2.31	2.61	2.45	0.340	0.5642
	2 – 4	2.41	2.00	1.77	1.79	0.313	0.7635
	4 – 6	4.37[b]	5.93 [a]	4.74 [ab]	4.17 [b]	0.333	0.0362
	Mean	3.00 [ab]	3.41 [a]	3.04 [ab]	2.80 [b]	0.471	0.0412

[a---b] Means within row followed by different superscripts are significantly different (P≤0.05).

Table (4): Effect of wet feeding on carcass traits.

Traits	Treatments				SEM	P value
	C	T1	T2	T3		
Dressed carcass, %	76.22 ^{ab}	74.46 ^{b}	77.00 ^{a}	76.81 ^{a}	1.632	0.0362
Heart, %	0.85	0.87	0.86	0.89	0.051	0.9625
Liver, %	2.66	2.59	2.68	2.73	0.325	0.7328
Gizzard, %	2.19	2.17	2.26	2.31	0.246	0.3582
Giblets, %	5.70	5.63	5.80	5.93	0.433	0.8425

a--b Means within row followed by different superscripts are significantly different (P≤ 0.05).

Table (5): Effect of wet feeding on some blood traits.

Traits	Treatments				SEM	P value
	C	T1	T2	T3		
Total protein (g/dl)	4.05	3.98	4.09	4.12	0.319	0.8603
Albumin (g/dl)	2.46	2.39	2.41	2.43	0.223	0.5681
Globulin (g/dl)	1.59	1.59	1.68	1.69	0.195	0.1654
A:G ratio	1.55	1.50	1.43	1.44	0.155	0.7561
Glucose (mg/dl)	15.51 ^{b}	17.75 ^{ab}	18.89 ^{a}	18.33 ^{a}	1.385	0.7568
Cholesterol (mg/dl)	168.31	170.52	165.29	163.62	8.96	0.1268
AST (u/ml)	189.92	193.55	184.66	182.65	7.425	0.5562
ALT (u/ml)	11.22	11.08	9.89	8.96	1.245	0.4265
Corticosterone	39.66^{a}	37.92 ^{ab}	31.92 ^{b}	32.11 ^{b}	1.675	0.0326
T-AOC (U/mL)	4.16^{b}	4.91 ^{ab}	5.22 ^{a}	5.28^{a}	0.433	0.0432
MDA (nmol/)	14.79	14.02	13.71	13.88	1.365	0.7856

$^{a---b}$ Means within row followed by different superscripts are significantly different (P≤ 0.05).

Table (6): Effect of wet feeding on physiological and healthy traits.

Traits	Treatments				SEM	P value
	C	T1	T2	T3		
Lymphocyte, %	61.03	61.32	61.88	62.85	0.62	0.8942
Heterophil, %	26.25	25.68	24.62	24.36	0.49	0.5685
H / L Ratio	0.43 ^{a}	0.42 ^{ab}	0.40 ^{b}	0.39 ^{b}	0.01	0.0446
Body temp. (C°)	41.84	41.63	41.22	41.11	0.26	0.1265
Plumage conditions	1.78	1.66	1.42	1.44	0.10	0.6348
Leg problems	1.52	1.60	1.38	1.42	0.15	0.3823
Mortality rate, %	3.33	0.00	1.67	0.00	--	--

a--c Means within row followed by different superscripts are significantly different (P≤ 0.05).

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الملخص العربى

استخدام العلف المبسوس فى تغذية السمان الياباني تحت ظروف الصيف

محمد فرغلى علم الدين فرغلى1 و على السيد جلال1 و ايناس أحمد محمد أحمد2

قسم إنتاج الدواجن- كلية الزراعة- جامعة أسيوط– مصر1
قسم الإنتاج الحيوانى و الدواجن- كلية الزراعة و الموارد الطبيعية- جامعة اسوان– مصر2

استراتيجيات كثيرة لتجنب التاثيرات الضارة للاجهاد الحرارى يمكن ان تبنى على معالجات غذائية معينة كالغذاء المبسوس. اجرى هذا البحث لدراسة تأثير استخدام الغذاء المبسوس فى اوقات حارة من اليوم لتخفيف التاثيرات السلبية للاجهاد الحرارى خلال موسم الصيف فى صعيد مصر. تم تربيت عدد 120 كتكوت غير مجنسة من السمان اليابانى عمر يوم فى بطاريات وقسمت الى 4 مجاميع (30 طائر/ مجموعة). غذيت طيور المجموعة الأولى على علف ناعم جاف (كنترول) بينما غذيت طيور مجموعات المعاملة الثانية، الثالثة و الرابعة (معاملة 1، 2، و 3) على علف مبسوس (1جزء ماء : 1 جزء علف) فى الساعة 1000-1300، 1300-1600، و 1000-1600 على التوالي. ربيت كل طيور التجربة تحت نفس الظروف السكنية و الرعائية. أوضحت النتائج المتحصل عليها أن مجموعات المعاملة الثالثة و الرابعة (معاملة 2، و 3) المغذاه على علف مبسوس فى الساعة 1300-1600 و 1000-1600 كانت متفوقة فى وزن الجسم، و الكفاءة التحويلية و نسبة تصافى الذبيحة و الحيوية بالمقارنة بالمجاميع الاخرى (مجموعة الكنترول والمعاملة الاولى)، ولكنها كانت ذو تأثير غير معنوي على العلف المستهلك، ودرجة تلف الريش وبعض صفات الدم. نستخلص مما سبق ان تغذية طيور السمان اليابانى على العلف المبسوس خلال الوقت الحار من اليوم (1000-1600) ربما يساعد فى تقليل قمم الانتاج الحرارى و تسهيل عملية التبخير وتقليل العبىء الحرارى مؤديا الى تأثيرات مفيدة ايجابية على اداء النمو و الحالة الصحية للطيور المرباه فى المناطق الحارة. وعلى ذلك يمكن التوصية بتغذية السمان اليابانى النامى على العلف المبسوس خلال الوقت الحار من اليوم تحت ظروف الصيف.